M A L A R I A

With special reference to its Prevalence in

Trinidad, B.W.I.,

With 75 Illustrative Cases and

Temperature Charts.

CHARLES FRANCIS LASSALLE

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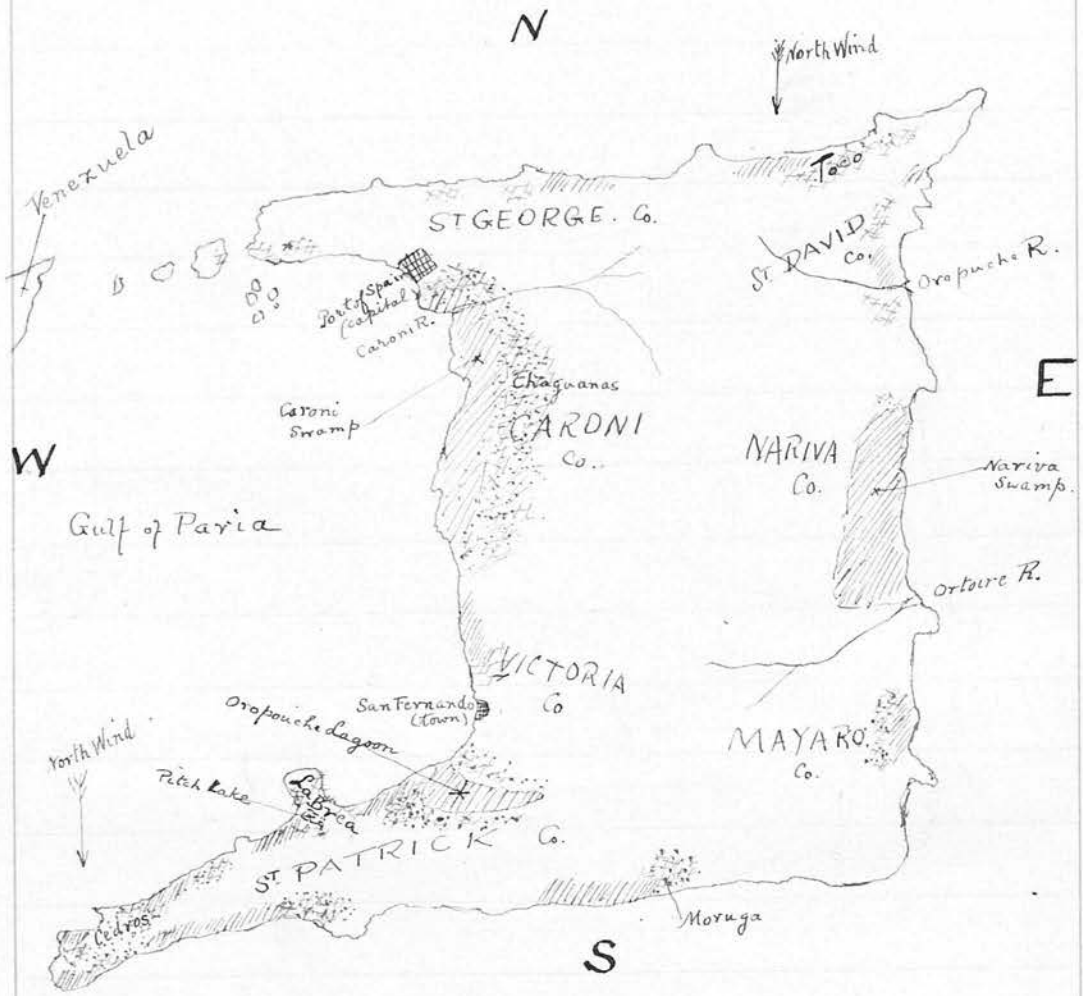

TRINIDAD W. I.

— Swamps

— Malarious Districts

— Parts in which Anopheles have been found.

M A L A R I A .

WITH SPECIAL REFERENCE TO ITS PREVALENCE IN TRINIDAD B.W.I.

Nomenclature and Synonyms.

The term Malaria is derived from the Italian Mal'aria which signifies "bad air". This term is now known to be a misnomer, thanks to the investigations of those illustrious men who have placed the aetiology of the disease or rather, group of diseases from the region of doubt and conjecture to the position of scientific stability, a stability which is being daily strengthened by the contributions of many independent investigators in all parts of the world. It is very interesting to note what the state of our knowledge was of this subject only a few years ago. In 1893 in the article on Malaria in Davidson's Hygiene and Diseases of Warm Climates, Davidson stated that the term Malaria however inappropriate etymologically, has been so generally accepted as signifying the infective agent of a well-marked group of febrile, cachectic and nervous affections, that we shall continue to employ it in this sense, and without prejudice to the question whether water or air is the medium by which the infective/

fective principle effects its entrance into the system.

The French employ "Paludisme" (from palus - a marsh), as equivalent to the wide term malaria and "Maladies palustres", or marsh diseases to designate the several malarial affections. These terms in the light of recent researches must also be considered to be misnomers. At the same time, it may not inaptly be stated that the term "paludisme", though an incorrect one, bears some affinity to the true aetiology of malaria in as much as the neighbourhood of swamps provides conditions most suitable for the development of the disseminator of malaria (viz., the mosquito).

The following terms are sometimes used as synonyms to designate the malarious affections:-

Gr. - Διαλειπων Πυρετος

L. - Febris intermittens;

E. - Ague, intermittent fever, remittent Fever; Marsh Miasm;

Fr.- (Fièvre intermittente, fièvre tellurique)rièvre périodique, mauvais air, (Intoxications des Marais: Intoxica-)tion Tellurique.

It.- Febre intermittente;

Ger.- Wechselfichen, aussetzendes fieber, Kaltes Fieber, Malaria.

Historical.

"The malarial fevers have been described from the earliest times. They were, however, throughout the older writings included without distinction among various other febrile processes, more especially, typhus, typhoid and relapsing fevers, and the different septic infections." Among ancient writers, many described with great clearness certain varieties of malarial manifestations. In fact, the intimate knowledge they show of all the varieties of Malarial Fever known to us is very surprising. The following quotation from Celsus is probably unique in its exactness; after having spoken of the Quartan fever he says, "Tertian arum vero duo genera sunt; alterum eodem modo quo quartana et incipiens et desinens; illo tantum interposito discrimine, quod unum diem praestat integrum, tertio redit: alterum longe perniciosus quod tertio quidem die revertitur, ex octo autem et quadraginta horis fere sex et triginta per accessiones occupat, interdum etiam vel minus vel plus; neque ex toto in remissione desistit, sed tantum loevius est", etc., etc. In these words is found a clear allusion to that type of fever termed by Marchiafava and Bignami, "Summer - Autumn tertian."/

tertian". The gravity (genus perniciosus) as well as the type is clearly acknowledged in them.

Hippocrates speaks of true tertians (spring) and of semi-tertians (summer - autumn), the one not fatal and the other, a very formidable fever. Pernicious paroxysms he ascribes to the supervention of other acute diseases. One year especially he observed that the (συνεχεις) continued malarial fevers (summer - autumn) were distinguished by an exacerbation every alternate day, after the manner of (spring) tertians.

Galen distinguished between continued fever, Synochus (typhoid or typhus)and subcontinued malarial (συνεχης); some (summer - autumn) subcontinued fevers having a daily remission like the quotidian (tertiana duplex and quartana triplex), others assuming the type of (spring) tertians, or, very rarely, of (spring) quartans.

Rhases dwells on the distinctions between the febris continens (typhoid, typhus) and the febris continua (malarial subcontinued), and clearly points out the close relation of the latter to intermittents.

Avicenna/

Avicenna calls the quotidian intermittent (spring, tertiana duplex and triple quartian) febris phlegmatica periodica; and the subcontinued quotidian (summer - autumn) febris phlegmatica inseparabilis or latica. The (spring) tertian is his tertiana periodica, and the summer-autumn subcontinued tertian, his tertiana continua. The two quartans he distinguished likewise as periodica and continua.

Paul of Egina says, "The subcontinued fevers (summer - autumn) are allied to each of the (spring) intermittents;" thus to the true tertian (spring) is allied the causus or ardent fever (summer-autumn); to the quotidian (double-tertian, triple quartan) that fever which has paroxysm every day, but does not terminate in a complete freedom from fever (summer - autumn); and in like manner to the (spring) quartan, is related that which has an exacerbation every fourth day (a malignant quartan not known in Rome).

These references are sufficient to prove the intimate acquaintance possessed even by the ancients.

HISTORICAL OUTLINE OF THE PATHOGENIC AGENT OF THE MALARIAL FEVERS.

A historical outline of the pathogenic agent of Malaria may now be conveniently considered. The idea that the malarial fevers are of parasitic origin is very old.

Varro (B.C. 118-29)* says: "Advertendum etiam si qua erunt loca palustria et propter eisdem causas, et quod arescunt, crescunt animalia quaedam minuta, quae non possunt oculi consequi, et per aera intus in corpus per os, ac nares perveniunt, atque efficiunt difficiles morbos."

Morton[x] in the seventeenth Century, maintained that the disease was engendered by marsh air. This air, charged with heterogeneous poisonous particles, and the autumn season with cold mornings and evenings, were, according to him, the causes of the malarial infection. This theory was accepted in 1716 by Lancisi and afterwards by Rasori and a number of other observers.

*(De Re Rustica, lib. I. cap. 12)

[x](Pyretologia opera Medica 4to Genevan 1696).

Lancisi believed that the disease was due to animalcula arising from putrefactive processes in the vegetable matter of swampy districts; these were inhaled and capable of entering the blood and multiplying there, thus giving rise to the pathological symptoms. This theory had many adherents, indeed, at the beginning of the last Century the idea had become so generally implanted in the public mind that the supposititious animalcula had become known in Italy by the definite name of "serafici". Even at the present day many people have faith in this theory, and with regret, it must be stated that even among members of the medical profession in the Tropics there are a few ignorant and obdurate sceptics who incline to the belief that malaria is introduced into the system by inhalation.

Bassi reports that Rasori in a conversation expressed himself as follows:- "For many years I have held the opinion that the intermittent fevers are produced by parasites which renew the paroxysm by the act of their reproduction, which recurs more or less rapidly according to the variety of the species."

(De noxiis paludum effluviis, Lib.II., Roma 1717).

*Discorsi sulla Natura e Cura della Pellagra, etc., 1846). Referred to by Calandruccio, "Augustino Bassi de Lodi il fondatore della teoria parassitaria e delle cure parassiticide p.70, Catarna 1892.

Virey believed the disease to be due to infection with infusoria.

Bondin 1842 - believed the fever was caused by the inhalation of poisonous volatile principles given off by certain plants which grow in the marshes. In 1849, J. K. Mitchell of Philadelphia, suggested that the disease was due to spores which were found in large numbers in marshy districts. The same idea was held by Muehry in 1856.

Lemaire studied the vapour collected just above the surface of the marshes in Sologne, a malarious district. Finding that the air here contained a marked excess of micro-organisms of various sorts as compared with that in a neighbouring healthy district, he inclined to the view that these lower organisms had a close casual connection with Malarial Fever.

Bonchardat believed that the process resulted from the inhalation of poisons produced by microscopical animalcula which flourished in the swamps.

Later in 1866, Salisbury described small vegetable cells of the family of Palmella, which he asserted he found in the urine and sweat of patients with malarial fever. These he believed to be the pathogenic agent. In 1868 Salisbury's views were satisfactorily controverted by Wood.

Binz in 1867, noted that the efficacy in Malarial Fever of quinine which he had shown to be an active protoplasmic poison, pointed to the possibility that the disease was due to infection with lower organisms.

Lanzi and Terrigi in 1875, described bacteria which they believed to be the cause of the malarial infection.

It remained, however, for Klebs and Tommasi Crudeli in 1879, to first excite a world-wide interest and a really extensive belief in the bacterial origin of the malarial fevers, so much so that the connection between the "bacillus malariae" and malarial fever was referred to as a settled fact in scientific journals.

These observers claimed to have proved

"1. That malarious affections may be produced artificially in animals in the identical forms known to human pathology.

2. That these artificially produced malarious affections are excited by organisms which are found in the soil of malarious places before the appearance of the fevers, and are, even then, diffused in the strata of the air nearest the soil."

Repeated researches, however, have clearly demonstrated the fallacy of the original ideas of these observers.

The/

The Parasites which are now generally recognised as the cause of the malarial fevers and which belong to the protozoa, were discovered in November 1880 by A. Laveran, a French Army Surgeon who was pursuing a systematic study of the malarial fevers at his post at Constantine in Algeria. Laveran published his observations in a short note to the Académie de Médecine in Paris, at a meeting on 23rd November 1880. Soon after he published a second note to the same Society giving the points in which the bodies found by him were differentiated from melaniferous leucocytes. In 1882, Richard also working in Algeria discovered other forms of the parasite which had escaped the notice of Laveran. As opposed to Laveran's view, which was that the parasite is affixed to the blood corpuscle from outside, Richard held it to be endoglobular ("ce microbe a un habitat spécial, le globule rouge de sang, dans lequel il se developpe comme un charançon dans une lentille.")

The Italian authors, Marchiafava and Celli held tenaciously to the theory of Klebs and Tommasi Crudeli in spite of the parasite having been demonstrated to them by Laveran (who went to Rome in 1882 for that purpose), and it was only in 1885 that Marchiafava/

Marchiafava and Celli suddenly changed their opinion in regard to these matters.

From 1885 more and more numerous confirmations of Laveran's discovery, which had been at first so dubiously received, came in from the most various malarial districts of the Globe, and their value was that they stimulated the study of the malarial parasite, and increased the importance of his discovery for diagnostic purposes. From the clinical standpoint, we have to thank Golgi for very valuable observations, for it was he who established the relation between the symptoms of fever and the various stages of development of the Haematozoon on the one hand, and between the types of fever and the forms of the parasite on the other. The advantages to the therapeutics of Malaria which have accrued from Laveran's discovery are not to be despised. Firstly, on account of the fact that the action of quinine can be defined with more precision than it has yet been possible to do with almost any other remedy or in any other internal disease; secondly, because it has now become possible to control exactly the result of our therapeutic measure, by examining the blood at short intervals during the administration of quinine, and by deducing therefrom the most favourable/

able conditions for their success. The investigations which refer to the first point were already made by Laveran on the living subject, whereas, later by Mannaberg and Romanowsky, by means of more accurate histological methods, the destruction of the parasites by the administration of quinine has been proved.

The questions, therefore, which Binz by a sort of presentiment, asked himself in 1867, at the time of his investigations concerning the action of quinine upon Infusoria, have at last been answered, namely, as to the nature of malaria, and as to the cause of the specific action of quinine.

We may now consider the General Conditions under which Malaria prevails:-

GEOGRAPHICAL DISTRIBUTION: Endemic malaria has, in the natural and civil history of man, a higher importance than that of all other endemic diseases to which the human race is subject. The latter are met with in more or less limited regions of the globe, but it is as yet impossible to define the geographical boundaries of the production of malaria. It is more frequent in tropical and warmer temperate climates. The regions where the most/

most severe forms of malaria are seen are for the most part in the tropics, e.g., Tropical America, and Africa, the disease becoming less frequent as the temperate and cooler climates are approached. The exact geographical limits within which malaria prevails are, however, very hard to determine. The disease is rare in Japan and some of the South Sea Islands, Australia and New Caledonia, while it is unknown in the Sandwich Islands, Samoa, New Zealand, and Van Diemen's Land. In the West Indian and Tropical Island of Barbadoes Malaria does not exist, the only cases met with being those imported from neighbouring islands in the majority of which it is exceedingly rife. The reason for the absence of Malaria in Barbadoes is supplied by the fact that Anopheles mosquitoes, the definitive host of the malarial parasite, are not found in the Island. In the Island of Trinidad, W.I., Malaria is endemic; it occurs abundantly and in its worst forms in the low lying parts adjoining swamps not far from the coast, often near the mouths of rivers, and it has been found that in whatever districts malaria has from time immemorial been known to be very prevalent, there, Anopheles mosquitoes and their larvae have been/

been discovered within the last few years. The accompanying map illustrates generally the prevalence of malaria in Trinidad.

SEASONAL PREVALENCE: There would appear to be an intimate connection between the prevalence of malaria and the seasons of the year. In considering the Tropics, we have to deal generally speaking with but two seasons, the dry and the wet. In the Island of Trinidad, W.I., the dry season extends from February to June, the wet season occupying the other months of the year with the exception usually of a very short spell of dry weather in the month of October known as the petit-careme.

The district of Chaguanas, one of the districts in which the writer has had opportunities of becoming acquainted with malaria in all its bearings, is one of the most malarious parts of the island. It is low-lying and there are swamps near the sea-coast a couple of miles from the main village, the drainage of which is very bad. In addition, there are in one part of the district during the wet season, very extensive rice-fields. The appearance of these fields is a very interesting study. On each side of the road, the land is divided into squares by/

by means of earth ridges, acres upon acres being so subdivided. As the rain falls, water collects in these squares in which the rice is planted. The coolies (i.e., immigrants from India) migrate in large numbers from all corners of the island to the rice-fields, while many live actually in the rice-fields during the whole wet season. All that they have in the way of a house is a mud or trash hut, the earth floor of which is either on, or as often, beneath the level of the surface of the surrounding water, and the roof and sides designedly to all appearances constructed for the purposes of super-abundant ventilation.

The denizens of these hovels, which vary in size and in each of which are huddled together more persons than could be with difficulty accommodated in a room twice as large, are necessarily exposed to all and the worst of the evil effects of malarial intoxication, and in fact, suffer greatly.

THE RELATION OF RAINFALL is very important, as in most tropical countries, fever is most prevalent during the wet season and this is especially the case in level coast plains, table-lands and other localities in which the drainage is slow or obstructed./

ted. The seasonal prevalence of fever is not determined by the drying up of the rains. The maximum of fever prevalence may precede the rains as in Rome and Algeria; may coincide with the height of the rains, as in Senegal and Mauritius; or, may follow the rains at an interval of one or two months as is the case in many parts of India. The relation in Trinidad is similar to that in Mauritius.

Although the rainy season does not in every part of the world determine the fever season, yet it must be admitted that it regulates it to a certain extent. The fever season is definitely regulated by the rains only in those tropical countries, e.g., Trinidad, where the temperature is high and uniform all the year round.

TEMPERATURE IN TRINIDAD IN 1900.

January	77.[illegible]	July	77
February	77.5	August	78.5
March	82	September	76.5
April	81	October	82
May	78	November	79.2
June	79.5	December	78

RAINFAL IN TRINIDAD IN 1900.

January	3.56 inches	July	7.95
February	.76	August	11.07
March	2.72	September	5.52
April	4.10	October	6.53
May	4.14	November	5.41
June	12.99	December	2.61
		For year	67.36

The key to the explanation of the varying relation of malaria to rainfall lies in the influence of the latter on the local breeding pools of the anopheles mosquito.

ATMOSPHERIC TEMPERATURE: A mean temperature of at least 60° F. is necessary for the dissemination of malaria. This condition exists in Trinidad as is shown in the preceding table.

RELATION OF MALARIA TO WINDS: It is believed by many observers that winds are capable of carrying malarial infection for considerable distances. Thus it is noticed that of the two banks of a stream in a malarious district, that side toward which the prevailing winds blow is the more affected. It has been adduced as a proof of this that strips of forest land seem sometimes to interrupt the spread of the disease, as if some infectious substance were filtered out. Lancisi believed that it was through the sacred groves, the removal of which was followed by a marked increase in the severity of Malaria in the Roman Campagna, that this region had been protected.

There is good evidence, however, for us to believe that the distance to which the infection can be/

be carried by the wind is usually limited. It is very doubtful if the malarial mosquito, the acknowledged and undoubted vehicle of malarial infection, can be transported very far from its native pool. The mosquito does not ascend more than a few feet from the ground, and in high winds or even in draughts of air, such as that from a punkah, immediately seeks shelter. It is certain that a vessel lying half a mile or even less, off a malarious coast, is generally safe even on the West Coast of Africa. A similar distance on land from a Malarial source is probably as effective. The horizontal diffusion of malaria by winds is probably extremely restricted. A city may be quite healthy, whilst its immediate vicinity may be pestilential. For instance, the town of Port of Spain, Trinidad, is on the whole healthy, whereas the district of Laventille not a half mile from the town is intensely malarial. One village may be sickly, whilst a neighbouring village may be healthy.

Cold winds often cause relapses of fever in those who have contracted the infection. Stanley, in his account of his travels in the Congo region, says: "While ascending the Congo with the wind astern/

astern, we were usually exempt from ague; but descending the Upper Congo, facing the wind, we were smitten with the most severe form of it." In the island of Trinidad there are two places, viz., Cedros and Toco, notoriously malarious, in which the incidence of the disease is attributed almost entirely by the residents and others, (even including those in the high walks of life) to the baneful influence of the North Wind. The "healthy" prevailing wind in these places is the East Wind, but during a certain part of the year, usually at the time of the change from Wet to Dry Season, the wind veers round to the North and continues for about a month or so blowing from that direction. This North wind is the terror of the people; it is looked upon as a thing to be avoided as much as possible, and so much are they imbued with the idea of its being a vehicle of malarial infection, that during its prevalence, windows and doors on the North side of the houses are kept closed in many cases, as it were to keep out the threatening evil. The North wind blows from over the open sea at Cedros and Toco; it is always somewhat chilly and naturally, like all cold winds, may cause relapses in those previously infected./

fected. One may go so far even, as to conceive the idea that a person whose system has been invaded by the malarial parasite, but whose vital power is barely sufficient to prevent the development of, and thus to effectually combat the attack of the parasite, may, when exposed to the chilly and enervating North wind, have his vitality so lowered, that the parasite gaining a favourable opportunity, overpowers all resistance and declares its presence, - nay, its victory - by giving rise to the symptoms of fever.

ALTITUDE: The altitudinal limit of malaria varies according to latitude. In Germany, malaria is scarcely met with at a higher elevation than 1300 feet; in Italy it is met with at elevations of from 1000 to 2000 feet. At Karman in Persia, it is severe at an elevation of 7500 feet, but here the summer heat is intense, the daily range great and the country is extensively irrigated. In India, malaria is met with at elevations of from 6000 to 7000 feet, perhaps even higher, but it is of a mild type, similar to the fevers met with in temperate climates. In Guadeloupe and Trinidad, W.I., fevers are rare at altitudes of from 500 to 600/

600 feet and disappear at altitudes of 1600 to 2000 feet. Malaria is prevalent all through Central Africa, and near the Equator it occurs at heights over 5000 feet and up to at least 3200 feet at 15° S. Latitude. But the general rule, viz., that the more severely malarious districts are all in low-lands, while the higher regions are usually exempt from the disease, obtains,as in other parts of the world, throught the Island of Trinidad. In this island the distinction between high and healthy localities and low and malarious ones is marked. As a striking instance, may be mentioned the district of St. Joseph. In this district, there is the town of St. Joseph the ancient capital of the island in the time of the Spanish occupation over a century ago. This is a small town situated on elevated ground (300 feet) on a small hill, and from its ideal position from a sanitary standpoint, betrays commend-able wisdom on the part of our forefathers. It has the richly deserved reputation of being one of the healthiest spots in the island. It is properly drained and in no part of it does water ever stag-nate. On the other hand, at the foot of the hill and extending to the south and west of it for miles upon/

upon miles, there stretches an immense plain, a place known to be rich in fevers of all degrees of severity.

In a malarious district, it has been shown that the dangers of infection are greater to one sleeping upon a lower floor of the house than to one living in an upper story. Hence one of the prophylactic measures which is strongly recommended is, that the sleeping apartments should be always in the upper story of a house. The Pontine Marshes in Italy are a vast focus of severe malaria. Those who work in these marshes go up to their dwellings on the Sepini Mountains to sleep, faithful to the popular tradition which teaches that the best means of protecting oneself from fevers is to sleep in an elevated place. On the other hand those who have to live on the marshes sleep in elevated beds or platforms raised a few metres above the ground on poles.

We have an excellent example of the way in which the propagation of malaria in the vertical direction is restricted in the same Pontine Marshes. The town of Norma is built on the top of a rock, 343 metres high, and is free of malaria, whereas Verifa, formerly a flourishing town and situated at foot of the rock has been decimated by malaria and at present consists of ruins and a solitary house with a mill.

EFFECT OF CHANGE OF CLIMATE: A sudden change of climate from a malarious to a non-malarious district predisposes, or rather, one should say, is sometimes followed by a fresh outbreak of the disease, in the case of a person who has suffered from malaria during his abode in the former district, but from whom all signs and symptoms have apparently disappeared before his leaving that district. It is also noteworthy and undoubtedly of great interest, that one may reside in a malarious district during a continuous period of several months or even years without contracting the disease, but become attacked by it immediately on, or soon after leaving it for a change to a healthy locality.

This warrants the supposition that many individuals in malarious districts may actually be the subjects of completely latent affections. That the malarial parasite may exist for long periods of time in the organism without producing symptoms, is abundantly proved by this, as also by the relapses which occasionly occur after very long intervals in cases where a second infection has been practically impossible. Bearing in mind the occurrence of these relapses after very long intervals, one must acknowledge/

acknowledge that there is no reason, theoretically, why sometimes a relapse might not simulate a primary attack. An individual might well be the subject of an infection from which spontaneous recovery might occur before the parasites had reached a number sufficient to produce distinct subjective symptoms. A relapse from such a case as this would of course be considered as the original attack.

There are facts which lead us to suspect that cases of this nature occur. Most of the instances of malarial fever developing in individuals who have moved into healthy regions are, however, probably cases where the infection occurred shortly before leaving the affected district - cases where the symptoms would have appeared under any circumstances.

It has also been asserted that in expeditions in Tropical Africa, attacks of pernicious malarial fever are particularly frequent at the end of long journeys after reaching the coast, while during the expedition, despite the exposure and exertion, the liability to such outbreaks is less. The reason for this fact - if fact it be - is not clear. Vide cases.

INFLUENCE OF TREES, HOUSES, etc. The intervention of a belt of trees between a "malarial" swamp and a village is said to protect the houses on the leeward side of the trees. Special properties have been ascribed to the Eucalyptus tree (Eucalyptus Globulus and Rostrata). It is related that a Convent situated in a certain part of the Roman Campagna was a hotbed of malaria to such an extent that human life was impossible and the Convent was abandoned, until the land was given out to the Trappist Monks who planted it with Eucalyptus trees and lived in the Convent subsequently without suffering from fever. It is extremely doubtful, however, if the Eucalyptus exerts any specific anti-malarial influence, whether by exhaling aromatic and antiseptic vapours from its leaves or otherwise. If the planting of it does lead to salutary results in malarial countries, it is most probably only as the ordinary effect of cultivation of the soil whereby the humidity is diminished - an effect which follows the planting of trees other than the Eucalyptus.

In the island of Jamaica, W.I., the experiment was a few years ago tried, of planting Eucalyptus with/

with the object of ridding a malarious district of "fever". The experiment met with absolutely no success.

Quite recently, the Board of Health of Trinidad wisely decided not to recommend to the Local Government, the expenditure necessary to try a similar experiment in that island.

DISTURBANCE OF THE SOIL, CLEARANCE OF FORESTS:

It has been observed in malarious countries, so long as the soil remains undisturbed, agues and the severer forms of fever are comparatively rare; but so soon as building, road making, and other operations implying soil disturbance commence, then severe malarial fevers appear. This was painfully, yet abundantly proved in Hong Kong in which town soon after British occupation, when building works, road making, etc., were in course of construction, the soldiers and others died by hundreds of pernicious fevers.

There was in like manner an outbreak of pernicious fever some years ago in the island of Jamaica during the laying down of the sewage pipes in the city of Kingston.

Strange, however, as it may seem, during the last/

last year or so (and even at present) similar sewage works have been carried on in the town of Port of Spain, Trinidad, without any untoward result or unusual incidence of fevers. This satisfactory state of affairs may possibly be due to extraordinary precautions which were taken. For example, the operations were carried on mainly in the dry season and antiseptics were most liberally used from the moment the digging was begun.

The clearing of forests for the purpose of cultivation of the soil or of road making is generally considered a fruitful cause of malaria. A few years ago, while additional railway lines partly through primeval, virgin forest were being laid down, the labourers suffered in large numbers from malaria. Manson states that it is difficult to explain these facts on the supposition that the only way by which malaria can be acquired is through the bite of the mosquito. The circumstances rather suggest that there is some other way by which it gets access to the human tissues, some resting phase that it assumes in unfavourable conditions as on the death of the mosquito. Possibly Ross's "black spores" have reference to this condition.

The/

The most recent explanation and that advocated by the Italian school is that the disturbance of the soil, whether in digging operations, laying railway lines and sewage pipes, road making, or clearing of forests, sets up conditions favourable to the development of the larvae of the mosquito, in other words, - produces suitable puddles for their growth.

DRINKING-WATER: It has long been a widespread view that malaria could be contracted from drinking impure water, but this view has definitely been proved to be incorrect. The view had been so firmly impressed on most persons in Italy that malaria was said to be synonymous with "Malacqua".

On the contrary, it is a fact that many persons living in a malarious locality suffer from malaria although they drink the purest water, whereas vice versa persons living in healthy parts have not contracted malaria after drinking marshy water, for experimental purposes.

SEX, AGE: Women are less frequently affected because less exposed than men. Malarial attacks are more common and more severe in young children than in adults. Examination of the blood of a large/

accordingly when they neglect precautionary measures and often in spite of all precautions, as has been the writer's experience.

RACE: The population of the island of Trinidad is in the true sense cosmopolitan and therefore offers special advantages for observations as to the susceptibilities of different races to malarial infection. Undoubtedly, the European is the most susceptible. Next comes the Indian (i.e., immigrant from India) and lastly the black or native.

THE NATURE OF MALARIA: may next be considered. It may be defined in the light of recent discoveries as a disease, or rather a group of diseases the result of infection by a parasite of the class Sporozoa, order Haemamoebida, whose definitive host is the Mosquito (Anopheles) and whose intermediate host is man and possibly other vertebrates. In man it gives rise to pyrexia and other signs and symptoms usually periodic in character, anaemia, enlargement of spleen and the deposit of black pigment in the viscera and elsewhere.

THE MALARIA PARASITE: belongs to the large group, Protozoa, of which it is one of the smallest;

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a historical account of the various steps that led up to the discovery of the various phases of the parasite need not be included in this account.

Classification: Malaria parasites of man are grouped with similar parasites of birds into a sub-order, hoemamoebidae of Class Sporozoa.

Order or Family:- Hoemamoebidae.

Genus I. Hoemamoeba - (Gametocytes similar in form to mature sporocytes).

Species 1. - Hoemamoeba danilewskii,
(Syn. Laverania danilewskii)
Halteridium danilewskii,
Parasites of pigeons, jays, crows.

Species 2. - Hoemamoeba relicta
Proteosoma grassii
Parasites of sparrows and larks.

Species 3. - Hoemamoeba Malariae
(Syn. Hoemamoeba laverani)
Parasite of Quartan Fever in Man.

Species 4. - Hoemamoeba Vivax
(Syn. Hoemamoeba laverani.)
Parasite of Tertian Fever in Man.

Genus II. Hoemomenas - (Gametocytes have special form (crescentic).

Species - Hoemomenas Precox
(Syn. Hoemamoeba precox; H. immaculata
Laverania Malariae)
Several varieties (at least two, possibly distinct species).

Parasite of the irregular, remittent, pernicious or oestivo-autumnal fever in man.

These/

These parasites (sporozoa) are represented by true and proper cellular elements consisting of protoplasm, a nucleus and nucleolus. They have the characteristic of living at the expense of other cells, that is, of being true endocellular parasites or cytophages. They have also an amoeboid phase during which in the absence of a cell wall, they are animated by characteristic protoplasmic movements. Finally they multiply by spores, hence their name (sporozoa).

The general characters of the Hoemamoebidae are as follows:-

1. Life at the expense of the red blood corpuscle.

2. Cellular structure, with a nucleus provided with an abundant quantity of chromatin.

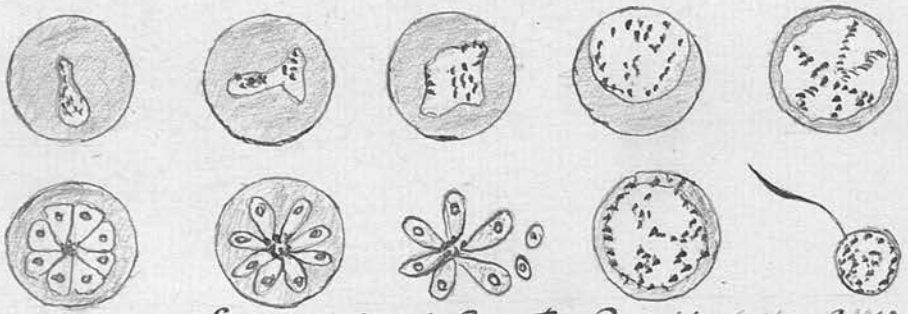
3. In the blood, cycle of life is subdivided into two phases; the one phase, endoglobular, which undergoes endogenous asexual multiplication into spores; the other phase that ends by becoming free in the plasma (the gamete or gametocyte). From this latter phase is initiated the cycle of sexual life within a mosquito or an acarus as the case may be.

4. Marked inoculability from animal to animal of the same species and variety.

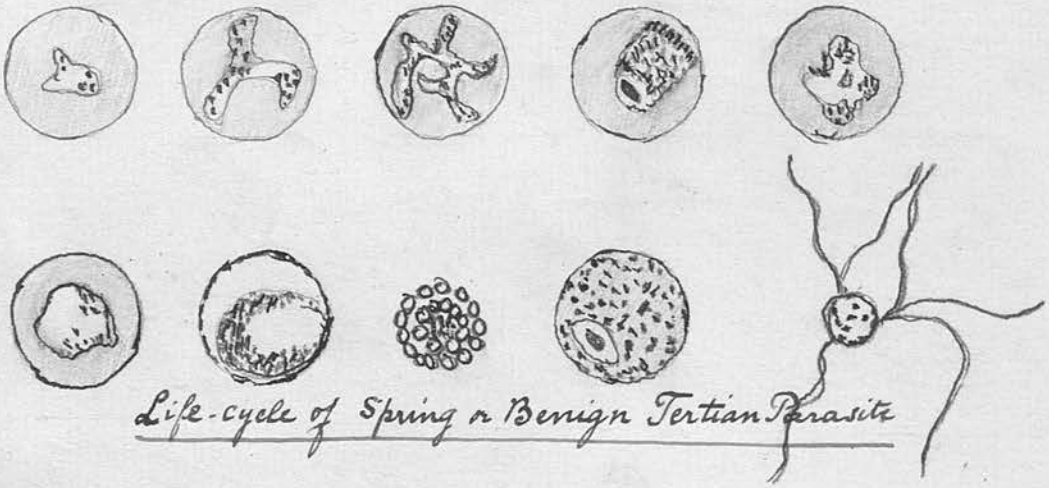
In 1883 King elaborated a theory that malarial disease is communicated by the bites of gnats or mosquitoes. In the following year, Laveran enunciated a similar hypothesis. In 1894, Manson propounded/

pounded the induction that certain forms of the parasites (gametocytes) are destined for further development in gnats; and the gnat theory was also accepted by Koch, Bignami and others on various grounds. In 1897 MacCallum proved the sexual nature of the gametocytes. In 1897 and 1898 Ross, following Laveran's and Manson's inductions, ascertained the life-history of this group of organisms in mosquitoes, found the mode of infection by inoculating a number of healthy birds by the bite of infected mosquitoes, detected two hosts of the parasite of remittent fever in India, and studied the habits of the insects there. These observations were almost immediately confirmed and amplified by Koch and Daniels. Bignami, Grassi and Bastianelli found the parasites in various species of anopheles in Italy and claimed to have succeeded in infecting men. Subsequently, Koch, Daniels and Ross and other observers found the alternative hosts and studied their habits in relation to Malaria, and the modes of prevention in various parts of the world. Manson has infected healthy persons in London by means of mosquitoes brought from Italy, and has experimentally proved that it is possible to remain free from the disease by living in a mosquito-proof dwelling.

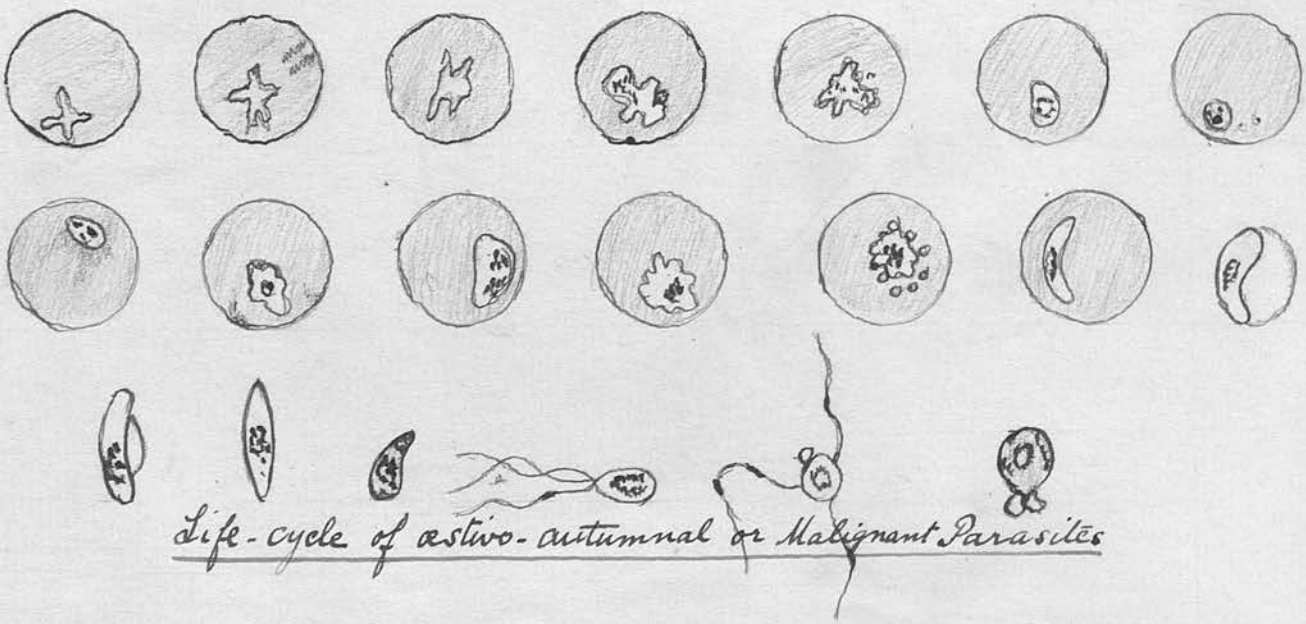
The perfect form of hoemamoeba, alike of birds as of man, is that seen in the mosquito, which therefore/



Life-cycle of Quartan Parasite (after Celli)



Life-cycle of Spring or Benign Tertian Parasite



Life-cycle of æstivo-autumnal or Malignant Parasites

fore represents the definitive host of the parasite, while the bird or man is the temporary host, because in its (or his) blood the asexual life only of the respective hoemamoebida develops.

In man there are two species of parasites for the mild fevers, and at least one for the severe or aestivo-autumnal forms. The spring tertian and quartan parasites give rise to the mild forms; the aestivo-autumnal quotidian (more rarely) give rise to the severe forms.

The Quartan parasite, Hoemamoeba Malariae, has the following characteristics:-

1. It completes its asexual life-cycle in three days.
2. It invades nearly the whole red corpuscle, but does not enlarge or discolour it, even when it has almost entirely filled the corpuscle.
3. Amoeboid movement is sluggish.
4. Pigment consists of coarse granules.
5. Towards the end of apyrexia the pigment collects in the centre and fission or formation of amoebulae begins. These are from 6 to 12 in number and are frequently arranged around the pigment in daisy-like form.

The Tertian parasite, Hoemamoeba Vivax, has the following characteristics:-

1. It completes its asexual life-cycle in two days.

2./

2. It invades the whole of the red blood corpuscle which becomes enlarged and pale. The loss of colour of the red corpuscle takes place when the parasite is still small.

3. The amoeboid movement is very active and pseudopodia may readily be seen through the microscope.

4. The pigment consists of fine granules which move actively.

5. Towards the end of apyrexia the pigment tends to collect in the centre, and multiplication begins. The number of amoebulae is greater than in the quartan, consisting of from 12 to 20.

Both the tertian and the quartan parasites also present the life-cycle which eventuates in the presence of large pigmented bodies free in the plasma, which in man are unable to proceed to their final stage of development, but are the beginning of a further phase of life, that is, the sexual life-cycle which is completed in the mosquito, and are called gametes or gametocytes. These forms have nuclei; some of them emit filaments or flagella which were considered perfect parasites by Laveran, "Moribund" forms by Grassi, and are now known as micro-gametes or spermoids. Those which emit these spermoids are the male free forms or microgametocytes; the microgamete fecundates a female free form or macrogamete.

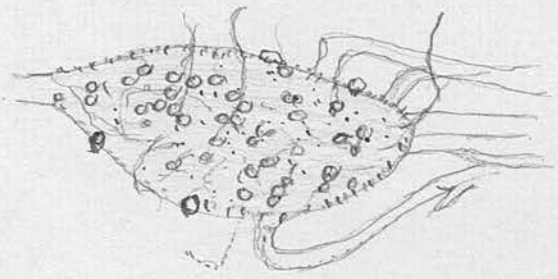
The/

The gametocytes of both the tertian and quartan parasites are spherical and similar in shape to the sporocyte before multiplication. The gamete of the tertian is much larger than that of the quartan. The forms of parasites that give rise to the severe aestivo-autumnal fever are principally those of the aestivo-autumnal tertian. The oestivo-autumnal tertian parasite (Hoemamoeba praecox) occupies a medium-sized corpuscle. Its amoeboid movements are very active when it is young. The smallest forms often contain no melanin at all, but frequently have the appearance of a little ring inside the corpuscle. Later the amoebulae form two or three masses of black pigment and retire to the internal organs. The sporocytes which, unlike the tertian and quartan, are very seldom found in the peripheral blood, are rather small and produce numerous small spores. The life-cycle lasts forty-eight hours. Only the young amoeboid forms and the gametocytes are found in the peripheral blood. The gametocytes have a peculiar shape - that of a crescent with a mass of black pigment granules near the centre. Some of these are male, and have the pigment granules lying separate; others are females and have the pigment granules close together, often in the shape of a ring. Shortly after the blood containing crescents/

cents is drawn, the crescents become gradually oval then spherical. Some of these spheres are practically hyaline, give out flagellae or spermoids and are males; others are granular and are females. The above description applies to the rare Quotidian parasite, except that its life-cycle is complete in 24 hours.

DEVELOPMENT OF EXTRA-CORPOREAL PHASE IN MOSQUITO.

The development of all the species in mosquitoes is practically the same; (the young tertian zygotes can generally be distinguished by their fine light-brown pigment.) The gametocytes circulate in the blood of man without undergoing any change, until they are ingested by an appropriate host - an anopheles mosquito. As soon as they are drawn into the stomach-cavity of this insect, they undertake their sexual functions. They burst from the enclosing corpuscle and swell slightly. The male gametocyte now emits four or more active motile filaments called microgametes, which are in fact spermatozoa (or spermoids). They are generally emitted from 10 to 30 minutes after the blood was drawn by the insect (they are also often emitted in an ordinary fresh microscopical specimen). After struggling/



Stomach of Anopheles showing Zygotes

(after micro-photograph by C.W. Daniels)

struggling for a few minutes one (or more) of them breaks away from the parent male cell, and, after wandering about in the liquor sanguinis, enters one of the female gametocytes, fertilizing it. This process has been actually seen by MacCallum. The fertilized female Gametocyte is called a Zygote. After a time it becomes elongated and motile and works its way between the epithelial cells of the stomach lining through the stomach wall and fixes itself on the outer surface of the stomach. Here it grows rapidly, still containing its original melanin granules, and assumes a very large size. The nucleus undergoes numerous subdivisions. After a week or so the Zygote, still fixed, is mature and consists of a capsule full of many hundreds of filamentous spindle shaped bodies called blasts (or sporozoites). The capsule now ruptures and the blasts escape into the general body-cavity of the mosquito, are carried by the lacunar circulation to the salivary gland where they accumulate in very large numbers and enter the cells of the gland. From these, they pass into the salivary duct. This duct opens at the extremity of the central stylet or lancet of the mosquito's proboscis - the salivary circulation being destined to pass into the wound made by the puncture. With this secretion, the blasts/

blasts enter into the circulation of a fresh host, and set up a malarial infection in him, (as proved by the numerous experiments of Ross, Daniels, Koch on birds and Bignami, Bastianelli and Manson on men).

The writer has repeatedly observed the development of the parasite, in the mosquito, in the laboratory of the Colonial Hospital, Port of Spain, Trinidad, more especially in the case of the malignant (or summer autumn) parasite.

THE MOSQUITO OR DEFINITIVE HOST.

It has been shown conclusively by all observers that it is the Genus Anopheles which is the agent not only of transferring the malaria from one human being to another, but in which the Heomamoebidae actually undergo part of their development. Experiments conducted by Ross and Grassi have shown that Culex does not act as an intermediary. Ross experimented with Culex fatigans and found that the human malarial protozoa did not develop in it. Grassi experimented with Culex penicillaris, C.albopunctatus, C. pulcritarsis, C. vexans, C. Richardii, C. pipiens, C. nemorosus, and C. annulatus, all with negative results. On the other hand Grassi has shown that certain Anopheles, notably A. Maculipennis (Claviger), A. bifurcatus, A. pseudo-pictus (= A. Sinensis)/

(= A. Sinensis), A. Superpictus, and A. Nigripes, can distribute the disease. Ross has shown that the parasites develop in A. costalis and A. funestus in Africa, and in another Anopheles (species uncertain) in India, Dr Christopher has found the parasites in A. paludis. Captain James has shown it to occur in A. Rossii and Dr Lutz has in A. Argyrotarsis. The writer has observed the changes in the parasite in A. Argyrotarsis (or albimanus) and A. annulipes, the two species existing in Trinidad, W.I. It may be mentioned that up to the present, besides these Anopheles, two species of Culex have been identified in Trinidad, viz:- Culex fatigans and Culex confirmatus and specimens have been sent to the British Museum; but there is no doubt that numerous other species, both of anopheles and of culex genera do exist and will before long be identified.

POINTS OF DISTINCTION BETWEEN CULEX AND ANOPHELES

Culex.	Anopheles.
The ova are laid in artificial collections of water about houses. They form tiny boat shaped masses appearing like soot on the surface of the water.	The ova are laid in natural collections of water, e.g., stagnant pools or small sluggish streams free from fish and containing algae, generally arranged in loosely connected masses and attached to sticks or weeds, etc.
Larvae - /	

Culex.	Anopheles.
Larvae - are very active and feed greedily on animal matter. They come to the surface of water to breathe with head hanging vertically downwards; the air tubes terminating at the caudal extremity in a long respiratory tube, determine this attitude. When disturbed they sink rapidly to the bottom of the water.	Larvae - are active and feed preferably on algae. They come to the surface of the water to breathe with body lying parallel to the surface. The air tubes terminate separately dorsally without any common respiratory tube at caudal extremity. When disturbed they glide away horizontally, tail first.
Mature insect - The male has palpi nearly as long as the proboscis with five segments. The female has diminutive palpi (much shorter than proboscis) with three segments. Most species have unspotted wings. When at rest on a plane surface, it assumes a position more or less with the axis of its body parallel to the surface.	Mature insect - Both male and female have palpi nearly as long as proboscis, each palp having five segments. Most species have spotted wings. When at rest on a plane surface it assumes a position almost at right angles to the surface.

The female mosquito alone sucks blood. The male is a vegetarian and is further distinguished from the female by having well-developed feathery or plumose antennae.

All the above characters of culex and anopheles have been the subject of daily observation by the writer.

The following brief descriptions of the two species/

species of Anopheles found in Trinidad are in part taken from Theobald's monograph on the Culicidae of the World.

1. Anopheles Argyrotarsis (Desvoid)

Syn: A. Albitarsis (Arribalzaga)

A. Albimanus (Wiedmann).

Thorax with mesonotum bluish grey with three longitudinal lines.
Abdomen - dark, dusky brown.
Legs covered with dark scales; last three joints of hind legs pure white and also apex of first.
Length: 4 to 5 mm.
Wings: costa dark, dour distinct patches.
Habitat: St. Lucia, Rio de Janeiro, Jamaica, British Guiana, Antigua, Grenada, Trinidad.
Time of Appearance: Rainy season in Trinidad. In dry season they practically disappear from houses.

2. Anopheles Annulipes

Syn: A. Musivus.

Thorax: brown;
Abdomen: fuscous; legs, including femora and tibiae much banded.
Wings: with many, four black patches along the costa and numerous small patches of dark scales on the veins.
Length: 5 mm.
Habitat: Queensland, Sydney, Mt. Kembla, Trinidad.
Time of Appearance: Rainy season in Trinidad.

The A. Argyrotarsis is by far the commoner of the two species in Trinidad and occurs at the proper season in large numbers near swamps in the malarious districts. This anopheles in the writer's experience/

ence can live for weeks in captivity under suitable conditions. It, however, is often difficult to breed as the eggs are deposited sometimes on any dry surface near the water.

The ANOPHELES ARGYROTARSIS was the species which the writer studied, and made observations upon, in 1900 and 1901. This particular species occurs in great abundance in the district of Laventille a marshy and malarious locality situated about one mile from the Capital in an easterly direction. Stationed at the hospital in Port of Spain, one had opportunities of obtaining mosquitoes for experimental purposes. Anopheles were caught in the houses of the natives at all hours of the day. The time which was most convenient was just before daybreak between 5 and 6 a.m., when mosquitoes were during the proper season found in large numbers, in some houses actually dozens were caught inside the net under which some one had slept during the night. From two such houses, mosquitoes caught inside the net were taken to the hospital, distended with blood. Two or three were killed and examined on consecutive days and the stages of development of the parasite in the stomach wall were clearly observed, proving that/

that the mosquitoes were infected and that the persons bitten were the subjects of malarial infection. The fact was that several inmates of such houses had suffered severely from malaria.

Other mosquitoes caught at Laventille were kept alive in a mosquito cage and bred in captivity. The form of cage used by the writer is a very simple one. It consists of a frame made of stout wire made up of a circle at the base and several hoops of wire attached to the circle at the base of the frame and overlapping and tied together at the apex. This frame is covered with mosquito-netting except the base which is left as an opening. Over the opening muslin is placed in such a way that it is like the mouth of an ordinary cloth bag with a string for closing it. The mosquitoes are transferred from test tubes in which they are caught and taken to the hospital, by inserting the mouth of the test tube (plugged with cotton wool) into the opening in the muslin. The strings are then drawn tightly around the test tube, the cotton wool plugging removed by the finger passed in along the tube, the mosquitoes fly up into the cage; both finger and test tube are then cautiously withdrawn and the baglike orifice is closed by pulling the string tight. The mosquitoes being/

being in the cage, the next step is to fix the cage on to a piece of board, say one or two feet square. This is done in the following way. Firstly food for the mosquitoes (viz., a piece of banana or other suitable food), and a small porcelain capsule or pot containing water (with some algae as well as a few bits of cork on its surface), also some gravel, are placed on the board near one another. Then the cage is lowered base downwards over them; the strings closing the opening are loosened and the orifice of the cage is opened widely but cautiously and quickly. The base is brought down on to the board, the cage being fixed by pins inserted into the board so as to fix down the circular base of wire. While this is being done, there is little risk of the mosquitoes escaping, as they usually fly upwards as soon as they have been liberated from the test tubes, and rest on the upper part of the cage.

vide Diagrams (opposite page)

Care should be taken to remove the fruit every day as it becomes dry. The water should not be allowed to become foul. Fresh water should be added daily. Especially should one be careful after eggs have been laid and larvae begin to develop.

For feeding mosquitoes on patients in the hospital wards, the writer used a small cylindrical or prism shaped cage made of similar materials as the large ones. At four corners tapes are attached by sewing. The cage with mosquitoes in it is tied by means of the tapes to the arm, thigh or leg of the patient. Usually anopheles were made to bite, and they bit readily through the mosquito-netting, at night. They were, after having had their fill, put into the larger cages. Those which had fed on patients, with crescents in their blood were killed, dissected, and examined on consecutive days, as a rule from the 2nd to the 8th day. The mosquitoes were killed in test tubes by simply saturating the cotton wool plugging with chloroform. It was found that there was a certain stage before the mosquitoes had been subjected to the chloroform vapour long enough to kill them, when they could be thrown out of the test tube on to the table apparently lifeless, but would after about 20 or 30 seconds begin to/

to move and show signs of life. They were then replaced in the cage, and very soon after would fly about as full of life as ever. As soon as the mosquito was dead, it was thrown out of the test tube into a few drops of normal salt solution containing 4% of Formalin on a slide. The wings, then the legs were carefully removed. The head was next removed. The thorax was fixed by holding it with a mounted needle. The two last segments of the abdomen were loosened by gentle teasing with the point of the needle. The thorax was torn open so as to loosen the anterior attachment of the oesophageal tube. Next, the last two abdominal segments were fixed by one needle and with another entangled in the thorax steady pull but very gentle was made on the anterior portion, when the alimentary canal and its appendages were drawn out, usually intact, attached to the hinder fragment. Formalin was added to the salt solution to preserve the specimens which were mounted and ringed with balsam. Numerous cases were so examined, and in nearly every one, the characteristic changes in the parasite were observed without much difficulty. These observations were made in the laboratory of the colonial hospital, Port of Spain.

Similar/

Similar experiments as those mentioned above were carried out, and the same results observed at the District Hospital at Chaguanas - the malarious district already referred to - with mosquitoes of the same species, viz:- A. Argyrotarsis.

The accompanying map of Trinidad indicates how the prevalence of malaria is practically coincident with that of anopheles throughout the Colony. In a few malarious districts Anopheles have not yet been discovered, the reason being that they have not been searched for.

METHODS OF EXAMINATION OF PARASITES IN THE HUMAN BLOOD.

Undoubtedly no examination can be satisfactory unless done with a good microscope with a good oil immersion $\frac{1}{12}$ in. objective; a $\frac{1}{6}$ dry objective answers well for preliminary examination of stained preparations. A sub-stage condenser and a mechanical stage are also necessary.

Blood may be examined either fresh or stained. One has found, however, that invariably fresh specimens are far better and give much more information than stained ones. Stained specimens are often quite unsatisfactory, whereas by one with a little experience in the examination of blood for malaria the/

the presence of parasites can hardly fail to be observed in fresh specimens of living parasites. Only in doubtful cases need one employ both methods of examination.

Before beginning to work, one should have cover glasses and slides perfectly clean. They should be kept in alcohol ready for use. The method adopted usually is as follows:-

Three or four cover glasses and slides are carefully dried and polished with soft linen cloth. They are then covered over so that they may be kept free of dust.

One cannot but digress here to give one's experience of methods as practised by some. The writer once saw a German naval surgeon examining some fresh specimens of blood on one of the plantations in Trinidad. The officer was accompanied by a sailor who carried microscope and accessories, and who handed slides and cover glasses to him as required. He carried the slides and covers in his pocket (dry), and all the formality was to wipe one of these with a dirty rag which he had in his hand and hand it to the officer, who examined case after case, and wonderful to relate, made full notes of his findings.

To/

To resume, having cleaned one's slides and covers, one next cleans the part of the patient from which the blood is to be taken, firstly with soap and water and secondly with spirit. The finger tip or the lobe of the ear is chosen. The writer always pricks the lobe of the ear. An ordinary needle having been sterilized by passing through the flame of a spirit lamp, is used. The first drop of blood which exudes is wiped off. The second is squeezed out, a little larger than the size of a pin's head. On to this a cover glass, held between thumb and middle finger is lowered so that it touches the drop without touching the finger. The cover glass is then placed, drop downwards, gently on a slide and after a few seconds, when the blood has run out in a thin film, it should be ringed with vaseline.

One has found that if cover and slide are not thoroughly clean, the blood will not form a proper film of itself and pressure has to be exerted on the cover glass to produce any film at all. After some experience in this matter, one is surprised to note that some authors recommend that the cover glass should always be pressed down.(vide Celli-malaria). If the preparation be a successful one, Newton's concentric/

centric rings will be seen on holding the preparation to the light. The preparation is then examined under a 1/12 oil immersion lens and those fields examined in which corpuscles lie flat side by side in a single layer.

For making stained preparations, dried blood films made on slides or cover glasses are used. After having cleaned cover glass or slide and patient's ear, one pricks the ear, wipes off first drop of blood as before. There are several ways of making films, (viz., gutta percha tissue, or cigarette paper), but the writer has made very good films by simply taking the drop of blood on a slide, applying the edge of another slide to the blood at an angle of 45° and drawing the second slide along the first. The films are air-dried, and then fixed by immersion in equal parts of alcohol and ether for ten minutes. The film is ready for staining as soon as the fluid has evaporated.

The following stains have been found to be those which give the best results.

1. Borax - Methylene Blue.

Formula - Pure medicinal Methylene Blue 2 per cent.
Borax 5 " "
Water (distilled) 93 " "

Filter before use. Stain for 30 to 50 seconds. The nuclei of leucocytes are coloured intense blue; the protoplasm of the parasite a fainter blue, nucleus unstained, nucleolus deeply-stained.

2. Haematoxylin and Eosin (contrast stain)

1. Ehrlich's acid Haematoxylin (or Delafield's), 5 minutes; previously filtered.

2. Weak Eosin ½%, ½ minute previously filtered.

Wash in water, dry and mount in Xylol balsam. This gives very good permanent preparations.

3. Romanowsky's Method.

Formula

Aqueous solution of pure medicinal Methylene blue 10% - 4 cc.
Aqueous solution of Eosin 1% - 10 cc.

This method gives good results, but it is difficult and takes a good deal of time, hence not recommended for ordinary clinical purposes. Both stains are filtered before use; they are mixed in above proportions and stirred. A precipitate forms. Pour this mixture on cover glass film in a watch glass and allow to stand for three quarters of an hour or even more. Wash in distilled water; dry in air; dip into absolute alcohol. Clear in Xylol. Mount in Xylol balsam. The red corpuscles are/

are stained a bright red and the parasites and nuclei of the leucocytes a blue colour. A third chromatin stain is produced, which stains the nucleolus of the parasites a deep carmine colour.

The following modification of Romanowsky's stain is recommended by W. B. Leishman in the British Medical Journal, 16th March 1901. The writer has tried it on several occasions, but without success. Advantages claimed for this special method are:-

1. Specific action of the stain upon all Red blood corpuscles infected by Tertian parasite - (viz., Schuffner's red dots.)

2. The greater certainty of the detection of very young intra-corpuscular forms of all varieties of the malarial parasite.

3. The facility with which the occurrence of a "mixed" infection may be detected, that is, the presence in the system simultaneously of more than one variety of the parasite.

4. The ease of its application and the certainty of the results obtained.

METHOD:-

(a) Preparation of blood-film:- Thin even film on a series of clean cover glasses. Do not touch cover glasses with fingers; use forceps.

(b) Fixing - in absolute alcohol and ether five minutes.

(c) Staining -

Sol. A. Med. Methylene Blue 1% Sol. Aq. Distil. Heat this in Tropical sun two days or warm room for one week. Add .25% Formalin to prevent growth of mould. Allow to stand for a week or two before use.

Sol. B. Eosin "extra B.A." 1-1000 sol. in Aq. D.
These concentrated stock solutions kept in stoppered glass bottles.

When to be used, dilute each with distilled water 1-25. Pour a measured quantity (2ccm.) of each into two watch glasses. Place the cover glass, film upwards in a third empty watch glass. The glasses containing the diluted A. and B. solutions are then picked up, one in either hand and their contents poured simultaneously upon the film. To ensure intimate mixture of two solutions, the cover glass is now picked up with a pair of forceps and used to stir the mixture. It is then replaced film downwards at the bottom of the watch glass and allowed to stain at room temperature for from half to one hour.

4. Carbol - Thionin Blue.

Stock Solution (1 grain Thionin Blue
) 100 cc. Carbol Ac. Sol.(1-40).

For use, dilute 1 vol. in 3 of water and filter.

1. Stain for 5 minutes.
2. Wash well.
3. Decolourise with very weak Acetic Acid (few drops Ac. Acetic in bowl of Water).
4. Wash.
5. Dehydrate in Absol. Alcohol or An. Oil

5. To stain Flagella, some form of moist chamber must be used. Cut a hole ½ in. square in a piece of blotting-paper the size of a slide. Moisten with water and lay on a clean slide. A film is made on another slide and inserted over the square hole in the blotting paper, face downwards, and while moist. About two dozen such preparations must be made. They should be allowed to remain for about half an hour then removed, fixed and stained by the Romanowsky method.

It is very difficult indeed, as one has found, to stain flagella. They may be seen more easily in fresh specimens a few minutes after the blood has been drawn, especially if the slide is moistened by breathing on it before the blood film is taken.

CLINICAL PHENOMENA AND RELATION TO STAGES OF PARASITES.

Seven years and a half ago when the writer started practice in the West Indies and took up an appointment as an Assistant Surgeon at a fairly well appointed hospital, all cases of malarial fever admitted, were diagnosed under one of three heads, viz:-

Intermittent Fever
Remittent Fever
Bilious Remittent Fever.

The hospital records are therefore not of much value/

value from a statistical point of view. Within the last three years, however, the diagnosis of fevers has been brought into line with present day knowledge of the subject and very shortly, no doubt, precise information of great importance statistically, as regards the prevalence of different types of fever, will be obtainable. The term Remittent Fever, as formerly applied, is no longer admissible. It had reference to any fever in which the temperature curve was such that it did not go to normal for several days, but in that period had a regular up and down variation, say 99.8° F. in the morning and 102° or over, at another part of the day.

It is now known that the majority, if not all, of the so-called Remittent Fevers are the result of infection by two or more generations of the same parasite, or sometimes of mixed infection by several species of parasite. Suppose, for instance, that a person is infected with two generations of the Benign or mild Tertian Parasite which mature at different times of the same day. There would then be a double series of clinical phenomena, and before the temperature could become normal after the pyrexia produced by the first group of parasites, the pyrexia produced by the second group would intervene./

vene. Hence the temperature curve would be "remittent" though the actual infection would be a mild and really intermittent one.

INTERMITTENT FEVER OR AGUE.

Typical malarial fever is made up of a series of attacks recurring at definite intervals of twenty-four, forty-eight or seventy-two hours. Each attack consists of,

(a) Premonitory Symptoms
(b) Cold stage, or rigor, or ague.
(c) Hot stage.
(d) Sweating stage.

These stages are followed by a period of apyrexia varying in length according to the nature of parasite causing the attack.

(a) Premonitory Stage. Before rigor sets in and sometimes for days (three or four), there may be a premonitory stage of lassitude, a desire to yawn, aching of bones, headache, general malaise, anorexia and a "chilly feeling down the back." The writer has had the bad fortune to experience this stage, which coincides with the last two or three days of the incubation period. His symptoms were exactly as described above and usually were followed by a typical attack of fever on each occasion, during his two years' residence in the malarious district of Cedros. During his recent residence in another unhealthy/

unhealthy district, viz., Chaguanas, for ten months, he has had the opportunity of proving to his satisfaction that an attack may be aborted during this stage. In the month of August 1901, after having been out one day between 8 and 12 in the morning, the writer reached home, and all the symptoms described above, and which from repeated attacks have become so familiar to him, suddenly without apparent reason came upon him. He felt disinclined to have his usual midday meal, but instead, took ten grains of Sulphate of Quinine and a cup of warm milk. He then went to his hammock, dropped off to sleep and three hours after, got up in profuse perspiration and with all symptoms gone. Again in December 1901, he had a similar experience with the same result.

(b) Cold Stage. This is the stage of rigor, and is described as the "ague" or ague fit. In French it is the "frissen", or chilly stage. In this stage, there is a feeling of intense cold throughout the body, so much so, that the teeth chatter and one shakes from head to foot. One finds that even with an atmospheric temperature of 80°F. one cannot feel the slightest warmth, even from several blankets or rugs, or even hot bottles. Vomiting/

Vomiting and headache may become very distressing. The features become pinched and fingers shrivelled. The vomiting is really very distressing sometimes. The writer, during a severe attack of malaria at Cedros, never felt so week and faint as when vomiting supervened in the cold stage, and gave cause for alarm to his attendants and friends. This is also the experience of a great many patients whom one has treated. The feeling of cold is entirely a subjective symptom, as during the height of the rigor, the surface temperature of the body may be 102 to 104° F. In young children, one has frequently noticed that convulsions have occurred during this stage, the convulsions passing away with defervescence.

(c) Hot Stage. After a time, varying in length, the cold stage gives place gradually to the hot stage. One feels waves of heat throughout the body and by degrees the feeling of heat is general; usually with great restlessness and headache and often with vomiting. The amount of vomiting depends as a rule on the condition of the liver, and if there be marked hepatic congestion, the vomiting is an urgent symptom.

In/

In this stage also general pain and localised pain are experienced, pain in the loins and in the splenic region being the most common. Often the pain on the left side is of a throbbing nature, and is such at times, as to prevent full inspiration. The writer has met with cases in which the symptoms were identical with those of pleurisy.

The pulse becomes frequent and bounding in character, the skin dry and the temperature varies from 103° in a very mild attack to 106° in a more severe case.

(d) Sweating Stage. After a time, varying between one and four hours in most cases, profuse diaphoresis sets in so that the clothes, and even bedclothes are saturated. One has seen sometimes that sweat has actually poured out from the skin and in such quantity that it poured through a mattress of ordinary thickness and even wet the floor. During this stage the pyrexia rapidly declines and the temperature in many cases goes below normal. This subnormal temperature is stated by Manson to persist in some cases for two or three days until the approach of the next ague fit; but the writer has seldom seen a subnormal temperature persist for more/

more than a few hours after the end of the sweating-stage. The subnormal temperature of the skin appears to be merely a physical result of the evaporation of the fluid sweat, and this being once completed the natural balance is restored and the normal body temperature is attained.

The patient in very many cases feels quite well as soon as the paroxysm is over. The history that one obtains in the majority of cases of typical benign infection, is that as soon as the sweating is over the patient is well, gets out of bed, walks about and even goes about his usual occupation until the next attack begins.

The Duration of a Paroxysm - is variable. On an average, the cold stage lasts about one hour,

the hot stage about three or four hours,

the sweating stage about two or three hours.

The Urine - is passed with increased frequency during the cold stage and is abundant and clear. In the hot stage it is scant and highly coloured, contains excess of urea and often bile pigment. In some cases it is albuminous. It is a very interesting fact, which one has been able to confirm, that as first demonstrated by Ringer after an attack, although/

although the return of fever may be prevented by the administration of Quinine, yet, for a time, a periodic increase in the excretion of urea occurs on the days on which the fever fit is due. Glycosuria is very uncommon.

The Spleen - becomes enlarged during the rigor. The enlargement subsides during the interval. Repeated attacks of ague cause the enlargement to persist and the splenic tunour forms a characteristic feature of chronic malaria or malarial cachexia.

The Period of Day at which Ague commences is stated by Manson to be between midnight and midday in the majority of cases. In Trinidad, one's experience does not tend to confirm this. One has met cases of ague beginning at any hour of day or night.

Relation of Clinical Phenomena to Stages of the Parasite: Golgi was the first who studied this relation. Before describing the different types of fever, it may be premised that invariably as one has always observed, the sporulation of the parasite or asexual multiplication in the blood is synchronous with the cold stage of the paroxysm. How or why the fission of the parasites should cause the/

the subjective sensation of cold is a question which has not yet been answered; it is nevertheless very interesting. The hot stage bears a relation to the production of toxins by the parasite. At least, the best explanation of the production of pyrexia is that it is the result of the effect of the toxin on the organism.

It may further be stated that the typical paroxysms, viz., quotitian ague recurring daily, tertian ague, recurring every second day and quartan ague recurring every third day are often not met with in practice. In a great many cases one has found double infection by the same parasite, e.g., two groups of Benign tertian forms maturing on different days, giving rise to ague daily, thus presenting the chart of a quotidian attack. On examination of the blood one always has found in such cases intra corpuscular parasites of different sizes, i.e., of different ages or stages of development. Of all the benign malarial infections in Trinidad, the Benign Double Tertian is by far the most common and exists in about 80 per cent of the cases. Such cases under treatment by Quinine resolve themselves after a few days into typical single infections and show as a rule characteristic charts.

Again/

Again, one has found Mixed Infections, i.e., the presence of groups of different parasites in the same patient, giving rise to quite a-typical temperature curves.

Quartan Ague is rare in Trinidad: they form not more than 2 per cent of cases of benign malarial fever admitted to the Colonial Hospital Port of Spain.

Malignant Infections - usually tertian, form about 10 per cent of all cases of malarial fever met with in Trinidad. They occur in the worst districts; the writer has found them in Cedros, Laventille, Chaguanas and Oropouche. They are rarely typical as regards temperature curve, and generally can only be diagnosed with precision by blood examination.

QUARTAN INFECTION.

The fever which the Quartan parasite (Hoemamoeba Malariae) gives rise to is more common in temperate than in tropical latitudes. As stated above, it is rare in Trinidad. It may occur as a single, double or triple infection depending on the number of groups of parasite. When single, it shows the typical/

typical temperature chart, i.e., a rise of temperature, preceded by cold stage, to 103° or 105° F. every third day.

When a double infection, it shows a daily rise on two successive days with one day's apyrexia after the second day.

When a triple infection, it shows a daily rise and the temperature chart is practically identical with that of the Double Tertian infection.

Quartan infection is mild as a rule, and does not tend to the development of malarial cachexia as do the other forms.

BENIGN TERTIAN.

This is the commonest form of the parasite, and occurs in all latitudes. As stated above, it is very often found as a double infection. The ague fit resembles that produced by the quartan except that the intermission is 48 hours instead of seventy-two. The typical chart of a single infection shows a rise to 103° to 106° every alternate day with one day's intermission.

MALIGNANT INFECTIONS.

These are caused by the "summer-autumn" forms of the parasite. Two forms of parasite are recognised, viz.,/

viz., Malignant Quotidian amd Malignant Tertian. The common and characteristic feature of both is that they form crescents, which are the gametes, i.e., forms for sexual generation outside the human body. The distinction between the malignant Quotidian and Tertian is a matter of some difficulty, firstly because the stages of development of these parasites cannot be followed throughout, in the peripheral blood. The quotidian form (unpigmented variety) is said to be smaller than the tertian and its pigment more minute and scarcely visible. Clinically in typical cases the distinction is that one gives rise to daily paroxysms, the other to paroxysms only on alternate days. The writer's experience in Trinidad is that a typical malignant single infection is never seen, but instead one invariably meets with double and mixed infections which give rise to quite irregular and atypical temperature curves, of a remittent or continued character. Again, one practically never observes in malignant infections the distinct and various stages of typical paroxysms (viz., cold, hot, and sweating stages.) These stages are not discernible. In some cases one has seen at the height of pyrexia, suddenly a short rigor, or shivering/

ing (corresponding to a cold stage) set in and last but 10 minutes or half an hour. This would go to prove the presence of multiple infection. In both Quotidian and Tertian infections, there is great tendency to the development of pernicious symptoms, hence the epithet Malignant, to the production of Cachexia and to relapses. The crescents have no connection with the production of pyrexia. They are formed usually only a week after the onset of symptoms, and they persist, as one found actually in several cases, for several weeks after the disappearance of the fever-producing forms and their associated fever. These crescents persist even during the administration of quinine. (vide cases.)

At the same time as crescents, pigmented leucocytes usually mononucleated, are found in the blood.

The segmenting forms of the malignant parasites are best found in blood drawn from the spleen - very seldom in the peripheral blood.

Malignant parasites give rise to pernicious signs occasionally. These may be divided into two groups,

1. Cerebral, and
2. Algide, which are subdivided by Manson as follows:-

1. Cerebral:-

(a) Hyper-pyrexial
(b) Comatose
(c) Convulsive - Tetanic
(d) Paralytic.

2. Algide:-

(a) Syncopal
(b) Choleriform
(c) Dysenteric
(d) Haemoglobinuric.

The cerebral forms depend on Embolism of the capillaries of the several nerve-centres as has been demonstrated by post mortem examination of fatal cases. The Algide forms are associated with coldness of the surface of the body, great prostration and collapse, the rectal temperature being high at the same time. One has seen a few cases of pernicious fever in Trinidad. In seven years and a half, one has seen but four cases of Haemoblobinuric Fever. One case occurred at Erin on the South Coast of the Island, one at Moruga also on the South Coast, one in Port of Spain in a European just landed from Brazil, where he had been travelling, and one in Tobago, i.e., the island North East of Trinidad. The cases were all contracted in intensely malarial districts. In two of them, malignant parasites were found in the blood. In the other two cases the blood was not examined.

Haemoglobinuric/

Haemoglobinuric Fever is rare in the West Indies, whereas it is common in some parts of Africa and those the most malarious parts.

The main symptoms are dark urine containing haemoglobin and often blood (a real haematuria); and distressing vomiting.

Another type of pernicious fever met with not infrequently is that known as Bilious Remittent. It is characterised by bilious vomiting, gastric distress, often bilious diarrhoea, sometimes constipation and always jaundiced skin and conjunctivae. This type is amenable to treatment by Quinine after the Hepatic functions have been regulated by such drugs as Mercurials and Salines.

DIAGNOSIS.

After a little experience, Malaria may readily in most cases be distinguished from other ailments. The main diagnostic signs are,

1. Periodicity of Fever in typical cases.
2. Effect of Quinine on the course of the disease. This is marked in two days if Quinine be given in full doses.
3. Presence of malaria Parasite in the blood. The microscope is the only infallible guide to a correct diagnosis, and one never omits to employ it more especially when any doubt exists.

It is a very sad reflection that in these days of enlightenment and of repeated and confirmatory observations on malarial parasitology, there are to be found some medical practitioners in Trinidad,- men holding British qualifications - who have absolutely no faith in the mosquito-malaria theory, who scarcely seem to believe that malaria is caused by parasites, and who boast that they are able to diagnose any case of malaria without a microscope. The matter is all the sadder considering their entourage and the opportunities which they have any day or hour of proving their ignorance.

PROPHYLAXIS.

All prophylactic measures must be based on a proper apprectiation of the habits of the Anopheles mosquito and of the life history of the parasites. There are two classes of prophylactics,

1. Sanitary,
2. Remedial.

Under the first class are the following methods; viz.,

(a) Diminution in the Numbers of Anopheles, by draining of swamps and all collections of stagnant water and thereby reducing the number of possible breeding pools.

(b) Protection from Mosquitoes by the use of mosquito curtains at night, as it is known that anopheles usually feed on man at night; also by building houses high off the ground and having sleeping apartments in upper stories.

(c) Isolation of European Settlements, say ¼ mile from native houses. This is based on the principle that natives and their children are the main source from which mosquitoes are infected. This measure could only be carried out in the country districts and even there, would present difficulties.

Under the second class, Remedial, are:-

(a) Quinine as advocated by Koch with the view of exterminating the malaria parasite in its intermediate host, man.

(b) Arsenic - is of no value, though recommended by some.

(c) Tea, Coffee, Alcohol in small doses are recommended.

The following admirable summary of the objects and methods to be followed in the campaign against mosquitoes is taken from Ross's most recent publication on the subject, viz:- "Mosquito Brigades and how to Organise them".

SUMMARY OF THE OBJECTS.

1. We do not propose to exterminate mosquitoes in an entire continent. We propose only to deal with them in the town or village in which we live and in its suburbs or surroundings.

2. We do not think it possible to drain or otherwise treat every breeding place in the town or village. We aim at dealing with as many as possible.

4. We cannot exclude mosquitoes, which may just possibly be blown into the town from miles away. We content ourselves with preventing the insects breeding in the town or village itself.

SUMMARY OF METHODS.

1. We start work at once with whatever means we can scrape together.

2. We operate from a centre outwards.

3. We clear houses, backyards, and gardens of all rubbish; empty tubs and cisterns containing larvae, or destroy the larvae in them by means of oil (Kerosene).

4. We show the people how to do these things for themselves, and how to protect tubs and cisterns by means of wire gauze.

5. When we have cleared as many houses as we determine to deal with, we clear them over and over again.

6. We fill up or drain away all the pools, ditches, old wells, and puddles we can, especially those which contain most larvae.

7. Such pools as cannot be filled up or drained, are deepened and cleared of weeds.

8. Streams and water courses which possess larvae are "trained".

9. Where we can do nothing else, we destroy the larvae periodically with oil, or by brushing them out with brooms, or by other means.

10. We endeavour to interest our neighbours in the work and to educate the town into maintaining a special gang of men for the purpose of keeping the streets and gardens absolutely free of stagnant mosquito-bearing water.

The first law of tropical sanitation is, <u>there must be no stagnant water</u>.

In Trinidad, appropriate sanitary measures are being adopted as the Government and its Medical Officers/

Officers are imbued with the soundness of the theory which dictates the expediency of such steps. The district of Cedros, for instance, once an intensely malarious focus, has within the past two years been shorn of its terrors, and malaria is much less prevalent, owing to the fact that a small swamp in the middle of the main village has been filled up in parts and drained. Further, the drains of the village have been very much improved, being of concrete instead of earth as formerly, with the result that there is scarcely ever any stagnant water. The Government has further issued circulars throughout the colony, embodying the statement of the mosquito-borne theory of malaria drawn up by Sir W. Foster, M.P., and urging the inhabitants to employ mosquito-curtains at nights and to be careful to keep the drains in the yards and around their houses clean. No doubt in a short time these wise steps will be rewarded by a great diminution of malaria throughout this island, as the subject of antimalarial sanitation is every day being studied and proper measures adopted on an increasingly large scale.

TREATMENT.

In the alkaloid of Cinchona bark, Quinine and any of its salts, we have a specific against malaria. It/

It is a specific in the true sense in that it directly attacks and kills the pathogenic agent, i.e., the malaria parasite. One has tried the effect of a solution of quinine - very weak - on the living parasite as seen under the microscope on a warm stage, by allowing some of the solution to run under the cover glass, and has found the movements of the parasite previously very active, suddenly become sluggish and in a very short time cease altogether. Quinine is said to act in another way by affecting the phagocytic activity of the leucocytes. The time of administration of quinine is all-important. It should be given in ordinary cases in 10 grain doses of sulphate solution every four hours, the first dose being given immediately the sweating stage has set in.

In severe cases, especially in cerebral cases, it should be given hypodermically. One has heard of a practitioner who never gave quinine in any other way than by hypodermic injection. But it is quite unnecessary and is even fraught with danger sometimes, no matter how scrupulously careful one may be to disinfect the needle. Local abscesses at the seats of puncture and other results, e.g., even Tetanus, have occurred.

Other/

Other drugs may be mentioned, Arsenic, Methylene blue, Carbolic Acid, Iodine, Opium, Eucalyptus, etc. There are a host of others which have been used. The writer has used Tincture of Sunflower with fair results, but not as good as with quinine. One has also used the Tincture of the leaves of "Herbe á Pique", a shrub which grows wild in certain parts of Trinidad, with fairly good results. It is much used by the natives and is a good post-malarial bitter tonic. It may be given by steeping in wine. There have been cases, however, in which even quinine properly administered and in full doses has been ineffectual. In some pernicious attacks one has administered quinine in large doses by hypodermic injection and by the mouth for two or three days without averting a fatal issue. In such cases it would appear that the parasites are in such vast numbers, as when they plug the cerebral capillaries, that quinine cannot affect them, or, it may be that the amount of the poison or toxin produced is such as to be lethal in spite of quinine - the antidote - which often is not administered sufficiently early in the course of the disease and only after a week or two after its inception, when the patient is taken to a medical man.

That/

That there are other methods of treatment which may not be quite as efficient as Quinine is just possible. For instance, what is known as the old women's treatment of Fever in the country districts of Trinidad is said to be efficacious. It consists firstly of a hot bath in which are boiled several kinds of leaves and bush, (known as a "bush" bath), while cold water is applied to the head. The bath is followed immediately by some hot tea made of a special leaf usually very bitter, such as Herbe á pique, with an ounce of brandy or whisky, and often five grains of calomel. The following morning, a dose of castor oil (one and a half to two ounces) is administered and on the next day a decoction of Senna, with Rhubarb, Cream of Tartar, and Jalap, as made up by the druggists. A cup of the same tea is given every night and morning. This has been known to cut short typical malarial attacks, no doubt due to the properties of some of the herbs used in the Tea.

Another plant known as Herbe piante is also much used. It bears a small pod in which are seeds somewhat resembling coffee-beans. The seeds are roasted, and ground into powder like coffee, and an infusion, not unlike coffee in taste, is made and given/

given by cupfuls twice daily. The Herbe Piante grows abundantly in all malarious districts. This fact would lend support to the statement one has heard, that wherever a disease is endemic, in that very locality there exists in plant form, its cure, which can always be found if one but search diligently.

Cacodylate of Sodium in the treatment of Malarial Cachexia finds an ardent supporter in Billet, of Constantine, Algeria. Quinine was given during the attacks of fever, and subsequently $3\frac{3}{4}$ grains of Cacodylate of Sodium were injected at intervals of three or four days. (New York Medical Journal, August 25th, 1900). The writer has no experience of the value of this drug.

Guaiaquin, which is said to be a combination of Guaiacol and Quinine, occurs as a dark crystalline, very deliquescent powder. It has been much used in America. The writer has used it as a substitute for Quinine with gratifying results, (except that it had a very marked diaphoretic action) under the following conditions in several cases:-

1. Where Quinine, as sometimes happens, could not be tolerated,
2. In pregnant women,
3. In ordinary cases, experimentally.

Serum Treatment:-

Kuhn (vide Medical Record, February 2nd, 1901) reports that by a serum obtained from horses which have contracted the so-called "sterbe" disease, he has succeeded in curing Malarial Fevers in South Africa. By injections of this serum, Malaria is said to become altered from a chronic relapsing ailment to an acute one curable in from two to six weeks; immunity is also said to be obtained. Of fifty immunised natives, none contracted the disease during the malarial season, whereas numerous other persons non-immunised fell ill, but were cured by the injection. There have not been as yet, any further confirmatory observations on this subject.

For the treatment of post-malarial debility and anaemia, i.e., the weakness and anaemia following an acute attack of malaria, as well as Chronic Malaria and Malarial Cachexia, Arsenic, either alone in graduated doses, or in combination with Citrate of Iron and Quinine and Tincture of Nux Vomica thrice daily after meals, is undoubtedly the best drug which we possess.

Enlarged Spleen is best treated by small doses of Iodide of Potassium internally in conjunction with Arsenic, etc., Externally, counter-irritation in the shape of mild measures such as Sinapisms, repeated/

repeated daily until vesication occurs, or Liniment of Turpentine over the splenic area; or stronger measures, such as wet cupping, fly blisters, or the actual cautery applied to the skin over the spleen, are of use. The ointment of Red Iodide of Mercury may be rubbed into the skin over the splenic enlargement and the part exposed to the rays of the sun. This treatment is much liked by the natives in the West Indies and the immigrants from India (coolies); no doubt, the scorching tropical sun's rays acting on the skin after rubbing, act as a counter-irritant.

The operation of removal of the Spleen or Splenectomy has been performed for malarial enlargement of the organ, but the results have not been sufficiently favourable to justify its adoption as a regular practice. The operation is said to be successful in cases of rupture and of enlargement, where Leucocythaemia is absent. Cases have been reported by the following:-

1. Heaton (British Medical Journal, August 19th, 1899), reported a successful case after rupture.

2. Ganz, (British Medical Journal, October 28th 1899) gave a summary of thirty-three cases with nineteen deaths. In one of these cases, the patient improved after the operation, but died two months after with enlarged lymph-glands and lymphatic oedema of the legs and tongue and finally delirium, the condition called pseudo-leukaemia glandularis being present.

3. Subbotic of Belgrade, (British Medical Journal 1900 Vol.I.; Epitome 101) did Splenectomy eight times. In all, there was a history of Malaria. There were two deaths.

4. Warren, (Annals of Surgery, May 1901, p.513) described four cases:-

   (a) No malaria; some anaemia; recovery.

   (b) History of Malaria ten years before, haemorrhage during and after operation; septic peritonitis and pleurisy caused death on sixth day

   (c) Leucocythaemia - recovery.

   (d) Rupture - death on fourth day.

5. D'Arcy Power, (British Medical Journal, November 17th, 1900) removed spleen; patient recovered.

A summary of all these cases shows that there were forty-seven operations with twenty-three deaths, a rather high mortality.

That there are cases of spontaneous recovery from malaria is an undoubted fact. One has known of numbers of cases of persons at Cedros and Chaguanas, who with typical mild malarial attacks have taken no drugs whatever and have yet recovered in a couple of weeks. Probably in such cases the parasites run a natural course, and the process of extinction is helped by the phagocytic action of the leucocytes as well as the endothelial cells of the spleen. The writer, on two occasions, in fresh blood preparations under the microscope, saw the process of phagocytosis. The leucocyte (mononuclear) was near a free spherical form of parasite, and gradually by throwing out pseudopodia, enveloped the parasite and its included pigment. Hence, pigmented leucocytes are always found in the blood after a time in all cases of malaria.

The writer would here state that he has not in the above description attempted to give a full account of the entire and vast subject of malaria. Many very interesting problems have been omitted, and one has rather kept in mind the state of affairs regarding the subject which exists in the Colony of Trinidad. This is, unfortunately one of His Majesty's tropical colonies in which due advantage has hitherto/

hitherto not been taken of the startling and epoch-making discoveries and observations which have recently so revolutionised our ideas with regard to tropical sanitation. It is pleasing, however, to note that within the past two years, there has been an awakening - a change of practice, and gradually, medical men are turning their attention to approaching the subject of malaria, its nature, its effects on the labouring class - a serious matter in a purely agricultural country - its treatment and, finally, its prophylaxis, along approved scientific lines. One foresees in the not very distant future that scientific ideas on this subject will filter down to the labouring class, the ignorant and superstitious natives.

LIST OF BOOKS, REPORTS, AND JOURNALS REFERRED TO ON MALARIA AND MOSQUITOES.

1. Reports on the Malaria Committee of the Royal Society; Harrison & Sons, St. Martin's Lane, London.

2. Celli's Malaria according to the New Researches, translated by Eyre; Longman, Green & Co., London.

3. British Medical Journal from 1896.

ON MOSQUITOES.

1. Giles' Gnats and Mosquitoes; John Bale, Sons & Danielsson, London.

2. Theobald's Monograph on the Culicidae of the World, 3 Vols: British Museum, London.

ON THE PARASITES IN HUMAN BLOOD.

1. Laveran, Du Paludisme, translated by Martin, New Sydenham Society, London.

2. The Parasites of Malarial Fever by Marchiafava and Bignami and by Mannaberg; New Sydenham Society, London.

ON THE WHOLE SUBJECT OF MALARIA.

1. Manson's Tropical Diseases; Cassell & Co., London.

2. Davidson's Hygiene and Diseases of Warm Climates; Young & Pentland, Edinburgh.

3. The Practitioner - special Malaria number, March 1901.

4. Lectures on the Malarial Fevers, by W. S. Thayer; D. Appleton & Co., New York.

ON ANTI-MALARIAL SANITATION.

1. Mosquito Brigades and how to Organise them, by Ronald Ross; Geo. Philip & Sons, London.

ILLUSTRATIVE CASES AND CHARTS.

The following short notes of a series of actual cases and charts will serve to illustrate some of the points mentioned in the text of the Thesis. They are some of the cases which occurred in the writer's practice. The charts are the original charts which were made at the bedside, and are interesting in that they are seldom typical or mathematically as precise as those given in text-books. They are mostly self-explanatory.

C A S E S .

I. E.P. - a medical practitioner living in Port of Spain in a healthy part of the town. Assistant Surgeon at Colonial Hospital where most of his time was spent. Goes to malarious district for a month; contracts Malignant Fever for which he is treated; recovers from attack. Shortly after, relapse occurs, but milder; this is recovered from; subsequently repeated attacks, and for some time, daily rise of temperature a few degrees and debility. Change to healthy island (Barbadoes) for three months; attack of fever there; returns well to Trinidad. Soon after, low fever recurs and gradually wears off. A case of Chronic and Persistent Malaria - Parasites - Malignant Tertian with Crescents.

II. R.S. - also medical practitioner contracts fever in Tobago - is treated and recovers; goes for a change of air for one month; returns to healthy district. Low fever recurs and lasts for month in spite of all treatment. Infection as above.

III. E.R. - Young lady, age 20; brought up in Scotland, whence she goes out to Trinidad, W.I.; lives in San Fernando, a hilly and healthy place. In some unaccountable way contracts fever and gets into "typhoid" condition - malaria (malignant) diagnosed in Trinidad. Fever persists for four weeks in spite of Quinine;daily rises of temperature diminish. With a daily rise to 100°F., she is ordered to Scotland via New York (America) in the hope that sea voyage and change of climate will restore her health. Arrives in New York; is seen by prominent physician there. She has temperature of 103°. Physician stops Quinine for two days and examines blood. Confirms diagnosis of Malaria. Administers Quinine for a few weeks. No improvement. Patient is then sent to Scotland. Treated similarly by other medical men in Glasgow, but dies about one month after reaching Scotland. Such a case is very difficult to understand if it were a pure case of Malaria.

IV. C.L. - the writer, lived for six months in a known malarious district (viz., Cedros) without suffering in any way from malaria. At the end of that period, he was ordered to another known Malarious district (viz., Chaguanas) where he spent five weeks; again free of Malaria. He was then ordered back to Cedros and one week after his return to that district contracted a severe attack of Malignant Malaria of the Quotidian type. The question which is of interest in this connection is, did the infection occur in the Cedros or Chaguanas District? The writer is inclined to believe that it occurred at Chaguanas, where it was latent and only became manifest a week after his leaving that district. This case exemplifies the latency which Malaria sometimes shows.

V. J.D.P., Government Medical Officer - stationed for nine months in Chaguanas, a malarious district; did not suffer from fever during that period. Shortly after leaving/

leaving the district (a month) he developed severe attack of malignant malaria(with parasites)from which he nearly died. This shows how malaria may at times, only develop-es after change of climate.

VI. E.C. - Postmistress at San Juan, a small station four miles from Port of Spain, for about two years. Suffered with very short intervals from attacks of fever in spite of treatment; locality apparently healthy; drainage good; swamps two miles distant. Anopheles found, but puddles not found, though searched for. E.C. then sent to Chaguanas Station, a malarious locality. There, became free of fever and has been so for past year, only precaution being a few grains of Quinine occasionally.
Question - Was E.C. rendered immune by repeated infections at San Juan?

VII. C.F.H. - went to Oropouche and La Brea, Malarious Districts; no fever there; returned to town and one month after, got an attack of Benign Tertian; treated four days with Quinine; eight days after, another attack and for two months, attack every eight days.

VIII. Infant three weeks old - mother subject of malaria just before childbirth; brought in in convulsion at 6 p.m. to Hospital, Chaguanas; Temperature 104°. Blood examined and small unpigmented amoeboid forms found in Red Blood Corpuscles in abundance - in some Red Blood Corpuscles double infection; died at 7.30 p.m., in spite of rectal injection of Quinine and Bromide, and hypodermic of Quinine.

IX. J.G./

IX. J.G. - an attack of malignant tertian; temperature curve remittent. Parasites found. Quinine Sulph. in full doses, 40 grains per day for about two weeks. Crescents found after first week. Temperature then, morning subnormal, evening 99° to 101°. Ordered to Barbadoes (where no malaria) for change. Quinine five grains morning and evening, and tonic. Gradually fever disappears and he picks up strength. Returns after three weeks to Trinidad and the following day Temp. 100°; 97° in morning. Continued subnormal in morning and 100° to 99° in evening for two weeks. Fever then left him, but very weak with large spleen and liver.

X. W.S. - Case of Malignant Tertian admitted with young forms; treated with Quinine, gr. 40 per diem. In two days after administration crescents appeared. In one week temperature normal; crescents still present and numerous; kept in Hospital for two weeks. No pyrexia, but still crescents. Sent out and given Quinine gr.v b.i.d. and tonic. Goes back to malarious locality. Remains free of fever for two weeks. Returns with fresh attack. Young forms seen, also crescents very few. Course as before; kept in Hospital for six weeks until no crescents could be found. This case shows how crescents may persist for long periods after all signs of fever have disappeared.

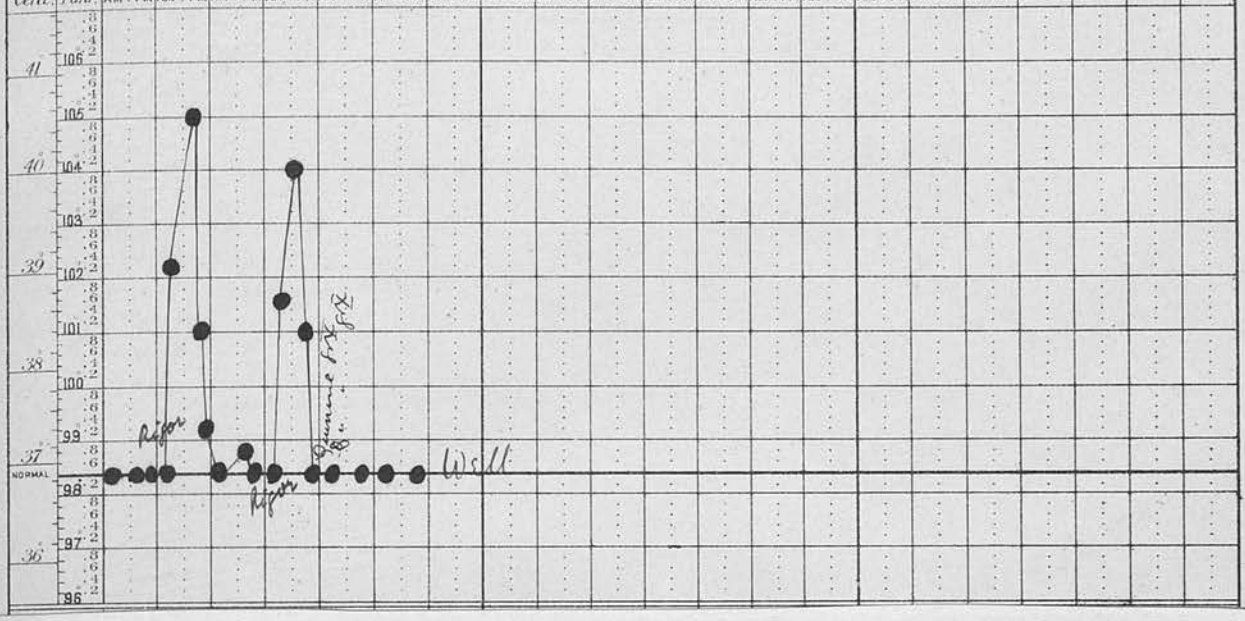
NAME. T Branch | RESIDENCE. | AGE. | SEX. | OCCUPATION.

DISEASE. Benign Tertian Fever

18 98 — DATES OF OBSERVATIONS

June 18 19 20 21 22 23

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM



A typical case of "single" infection with tertian parasites which were found on examination of blood.

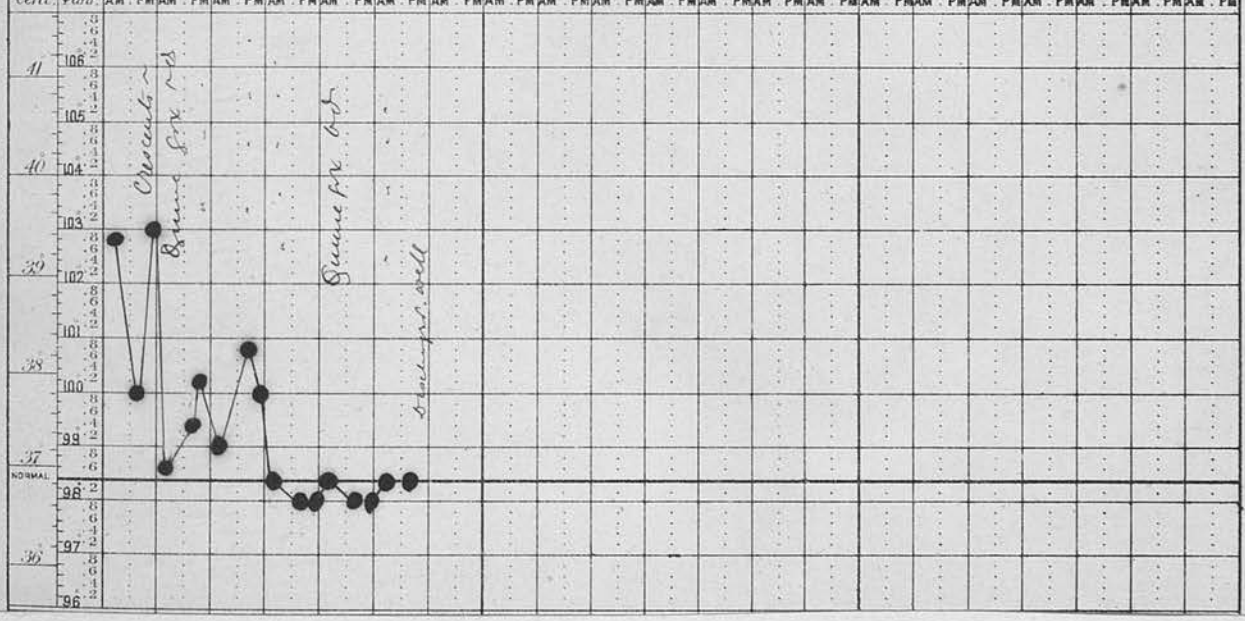
NAME. Margaret | RESIDENCE. | AGE. | SEX. | OCCUPATION.

DISEASE. Malignant Tertian Cerebral

18 98 — DATES OF OBSERVATIONS

July 20 21 22 23 24 25 26

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM



A case of infection with Malignant tertian parasites - Crescents were numerous, and some persisted even up to date of patient's discharge from hospital.

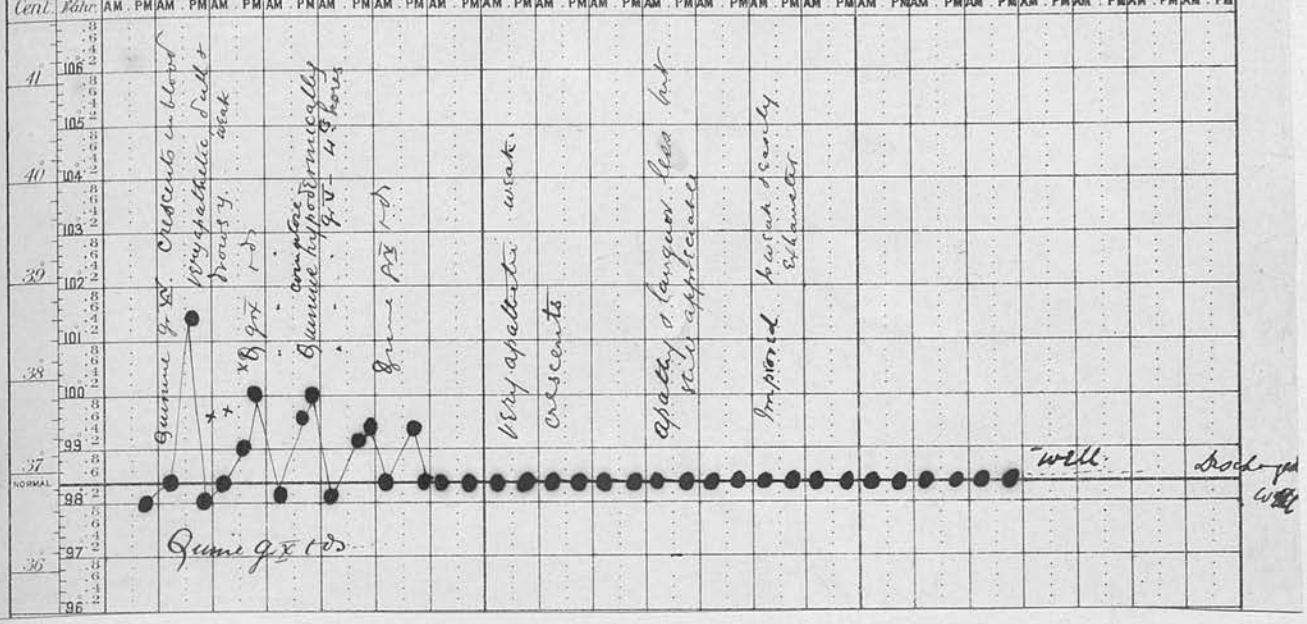
NAME. Laban Nunes | RESIDENCE. | AGE. 19 | SEX. M | OCCUPATION. Sailor - Coasting

DISEASE. Malignant Quotidian Fever - Comatose

18 99 — DATES OF OBSERVATIONS

June 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM



A case of malignant Quotidian infection, had existed for a week before admission to hospital. On admission, small amoeboid, unpigmented, intra corpuscular forms seen. no crescents in blood when discharged.

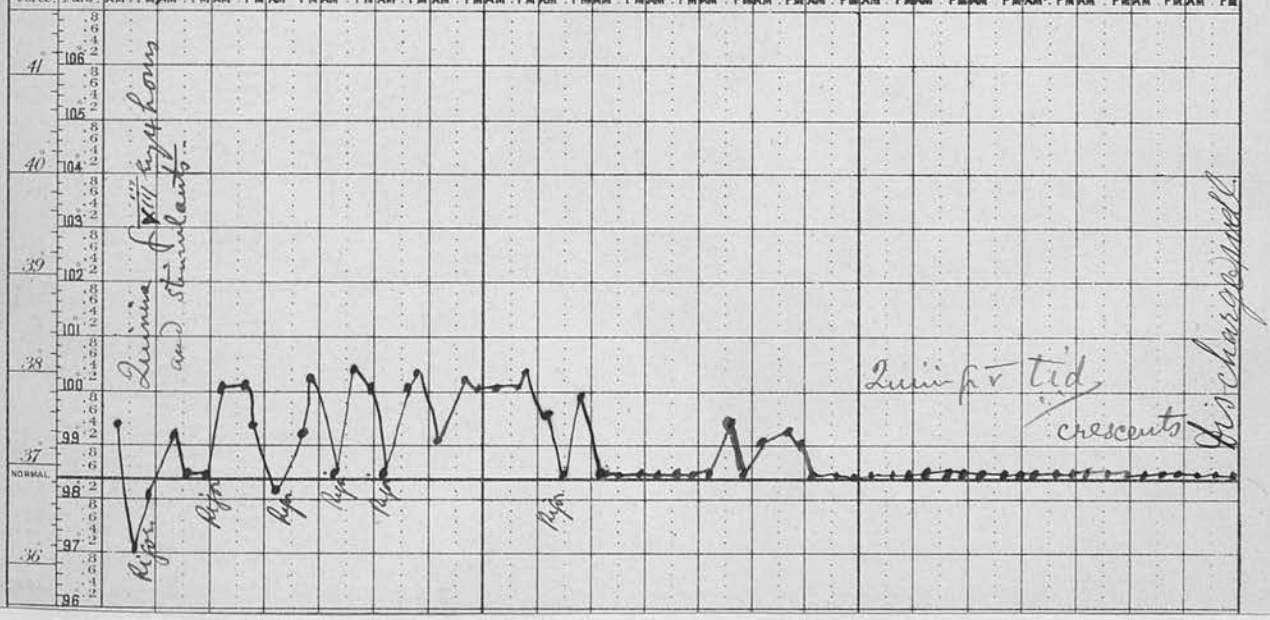
NAME. J. D'Andrade. | RESIDENCE. Rel Savanah St. | AGE. 10 | SEX. | OCCUPATION. Labourer

DISEASE. J. D'Andrade. Anaemia and Malarial Fever (Malignant Tertian)

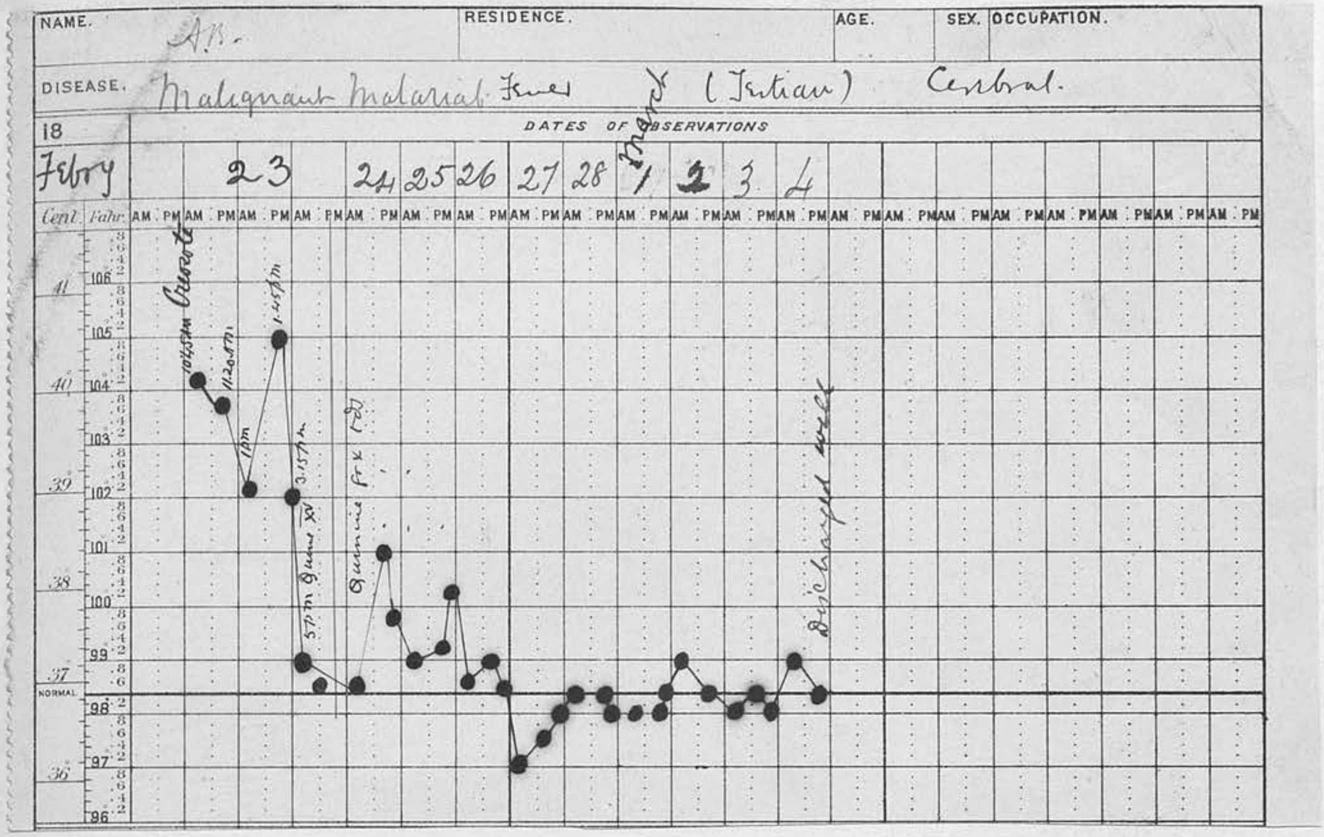
18 — DATES OF OBSERVATIONS

Nov. 30 Dec. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

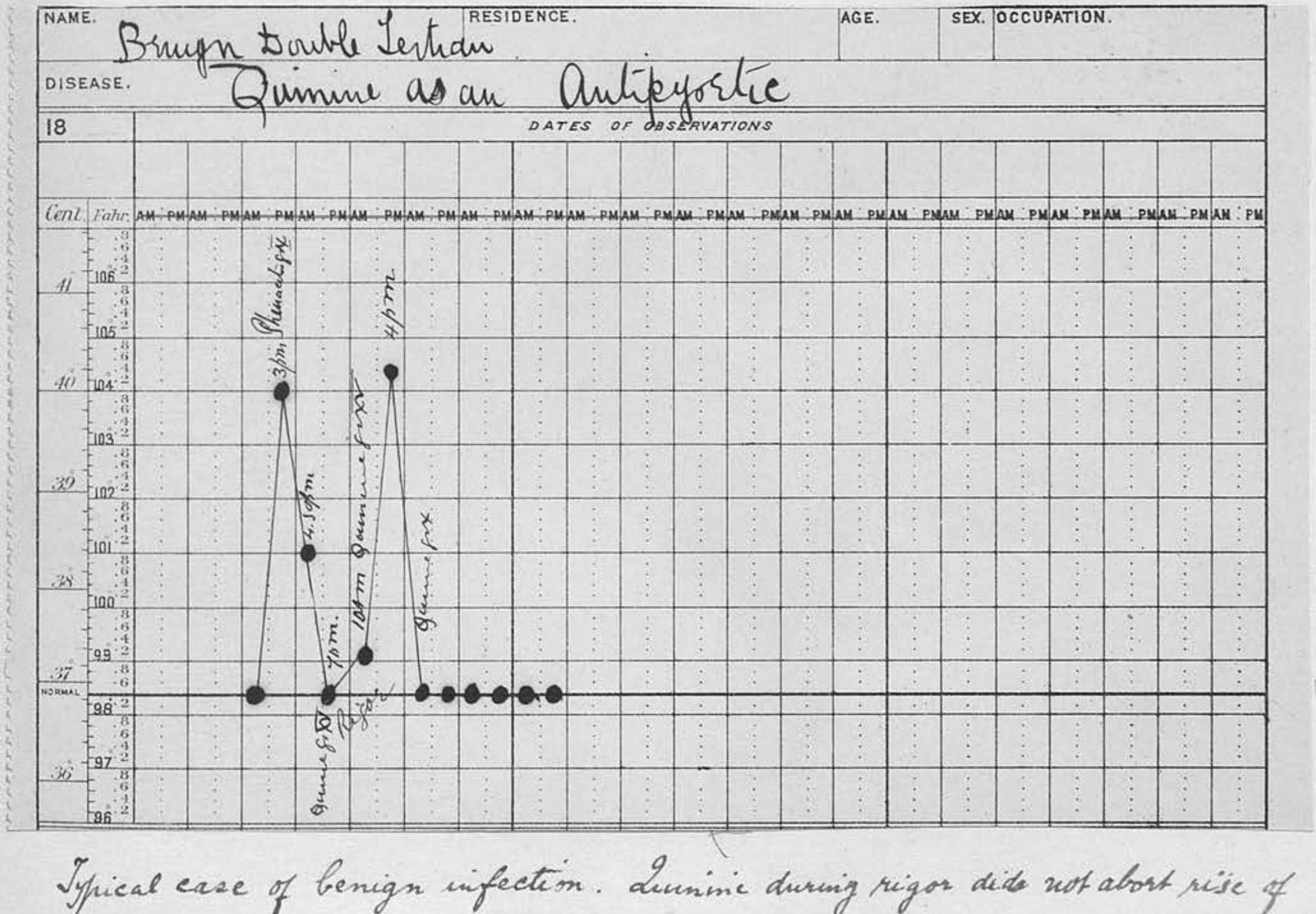
Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM



A case of intense anaemia, typhoid condition on admission. Exam. of blood showed Malignant Tertian Parasite - with formation of crescents.



Examination of blood shows malignant tertian parasites in red corpuscles as well as crescents. A few crescents present when patient left hospital.



Typical case of benign infection. Quinine during rigor did not abort rise of temperature.

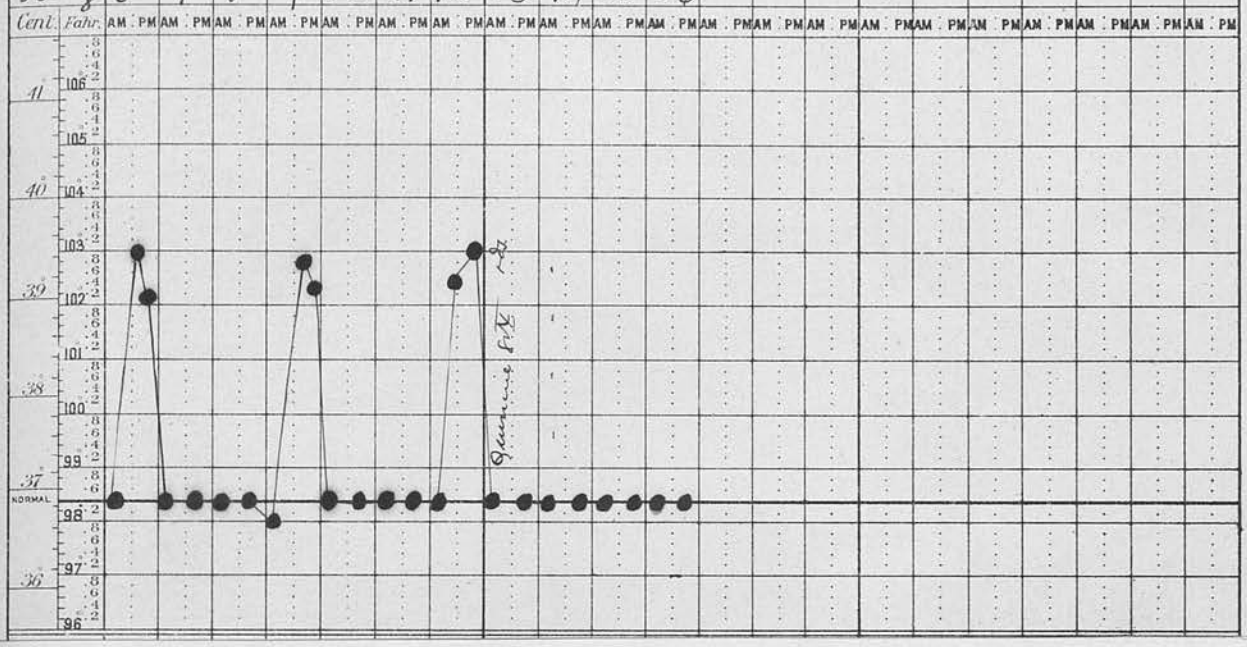
NAME. Palea | RESIDENCE. | AGE. | SEX. | OCCUPATION.

DISEASE. Benign Quartan Fever

No. 300

DATES OF OBSERVATIONS

July 6 7 8 9 10 11 12 13 14 15 16



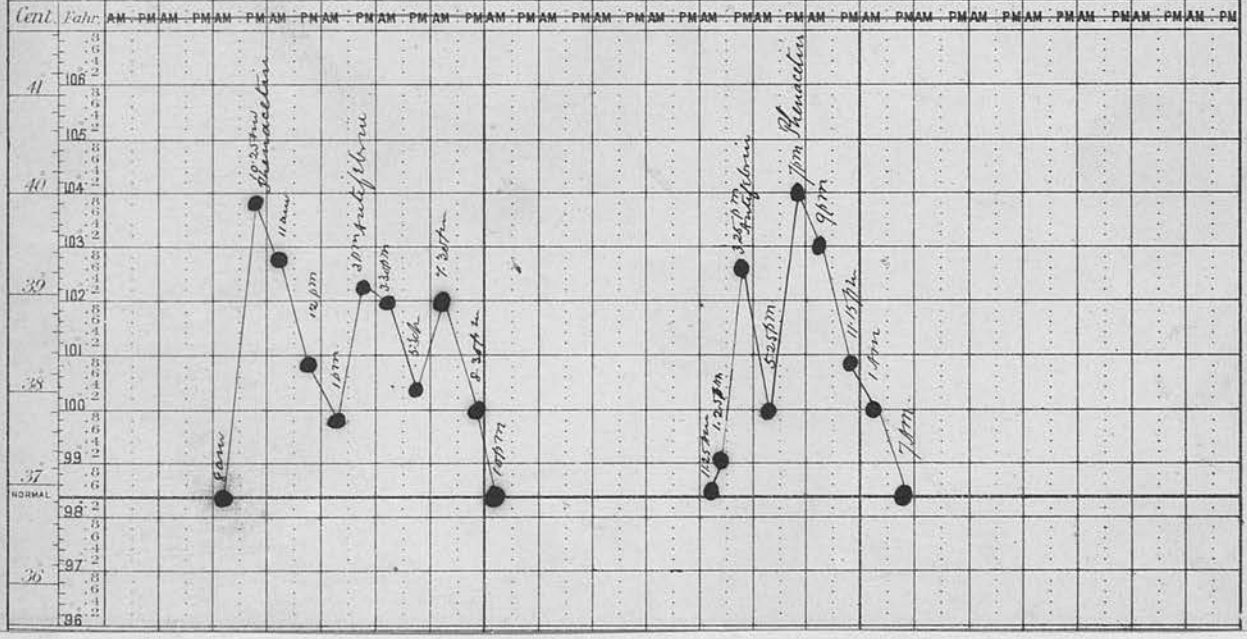
Characteristic parasites of Quartan infection found in blood examination.
Effect of Quinine shown, given at sweating stage.

NAME. | RESIDENCE. | AGE. | SEX. | OCCUPATION.

DISEASE. Benign Double Tertian. Antifebrin & Phenacetin as Antipyretics

18

DATES OF OBSERVATIONS



Blood Examination showed benign tertian parasites.
Compare antipyretic action of Phenacetin and Antifebrin.

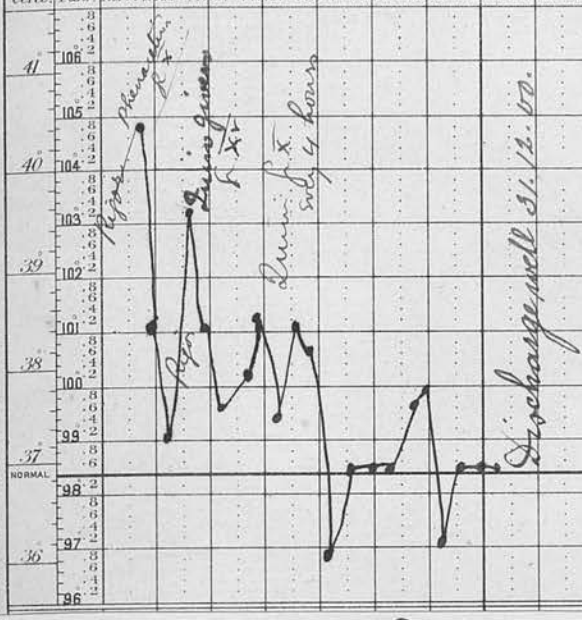
NAME. Philip Penco. RESIDENCE. Fragarette Road AGE. 16 SEX. M OCCUPATION. Nil

DISEASE. Malarial Fever (Benign Double Tertian)

1900 DATES OF OBSERVATIONS

Dec 24 25 26 27 28 29 30 31

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM



Blood Examination: Dec. 24th. Tertian parasites, double infection, of red corpuscles when discharged - free spherical forms and leucocytes containing pigment.

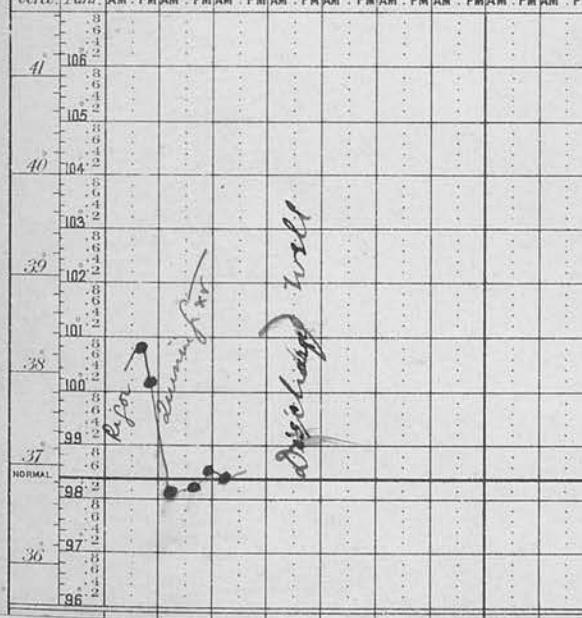
NAME. James Watley RESIDENCE. Cowra Exchange Village AGE. 36 SEX. M OCCUPATION. Journalist

DISEASE. Malarial Fever (Benign Tertian)

1900 DATES OF OBSERVATIONS

Dec 23 24 25

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM



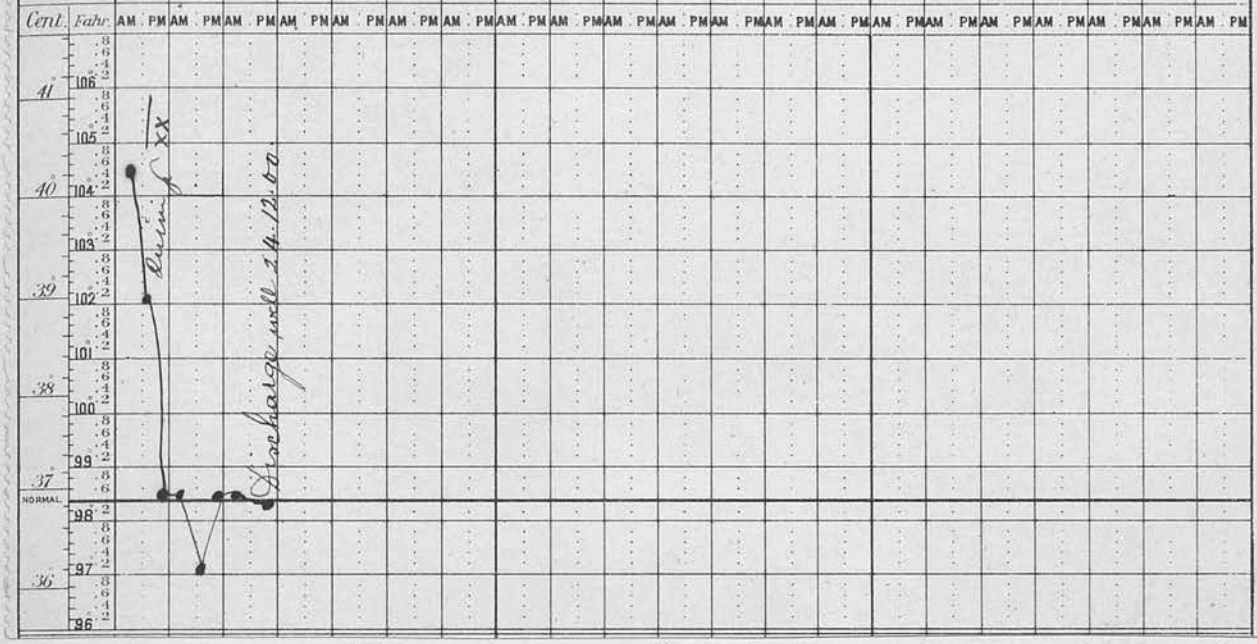
A very mild case showing benign tertian parasites.

NAME. Hubert Lewis | RESIDENCE. La Victoria, St Ompia | AGE. 24 | SEX. M | OCCUPATION. Road overseer.

DISEASE. Malarial Fever (Benign Tertian)

1900 — DATES OF OBSERVATIONS

Dec 22 23. 24



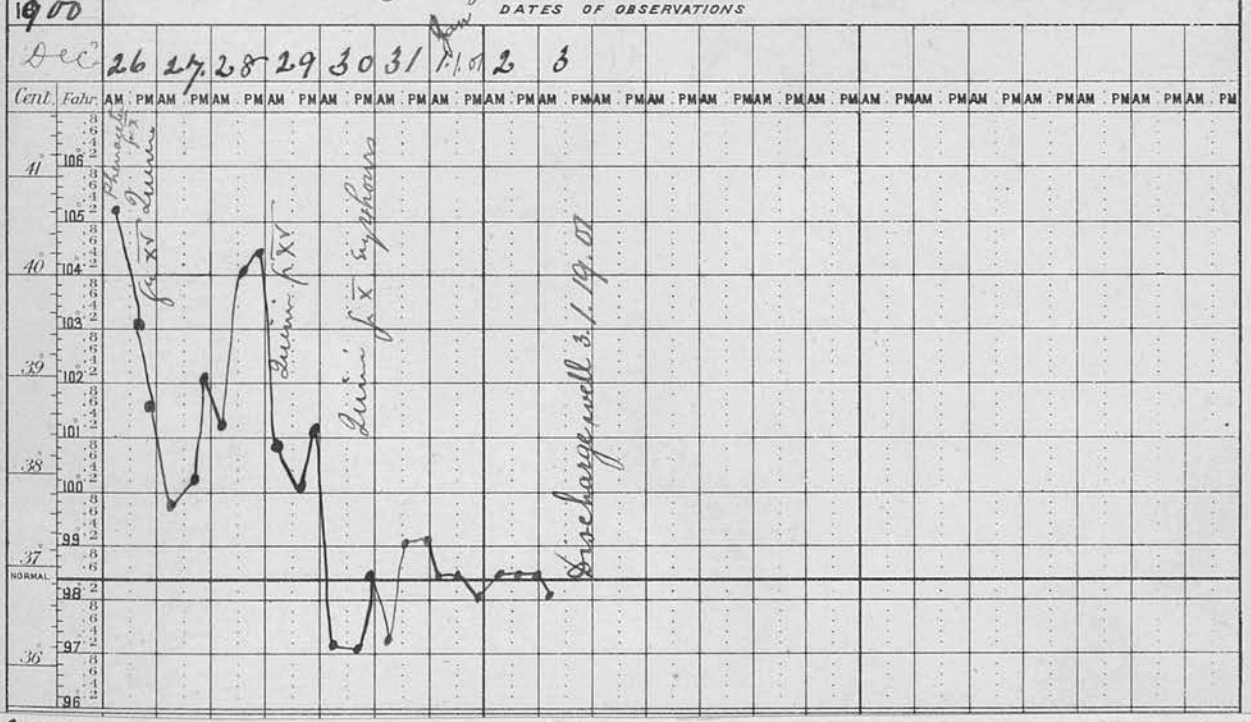
Benign tertian infection of red corpuscles - Quinine gr xx administered in sweating stage with immediate effect.

NAME. Arthur Douglas | RESIDENCE. Picton Road. | AGE. 16 | SEX. M | OCCUPATION. Sail

DISEASE. Malarial Fever (Benign Double Tertian)

1900 — DATES OF OBSERVATIONS

Dec 26 27 28 29 30 31 Jan 1 2 3



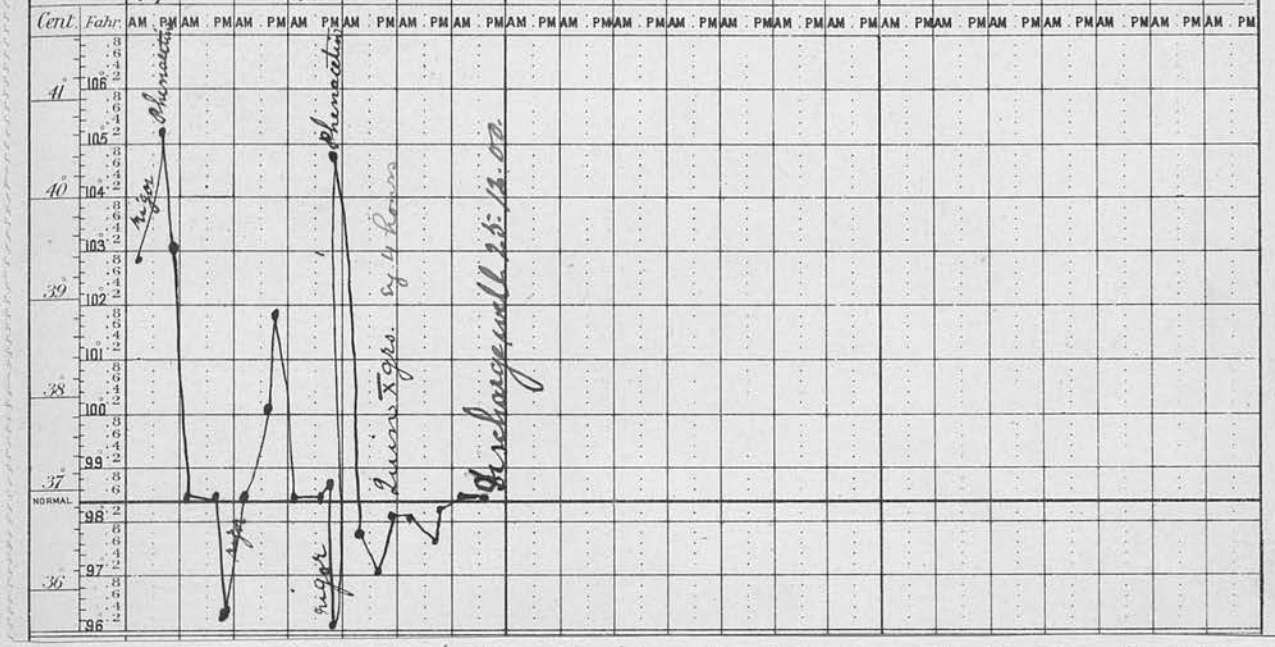
Blood examination on admission showed multiple intra-corpuscular infection with benign tertian parasites. Chart shows effect of Quinine gr xv in sweating stage and gr x every 4 hours in interval. Blood examination on day of discharge showed spheres with pigment, and pigmented leucocytes.

NAME. David Edmis | RESIDENCE. 19a North St. E.D.R. | AGE. 30 | SEX. M | OCCUPATION. Labourer.

DISEASE. Malarial Fever (Benign Tertian)

1900 — DATES OF OBSERVATIONS

Dec. 19 20 21 22 23 24 25 26



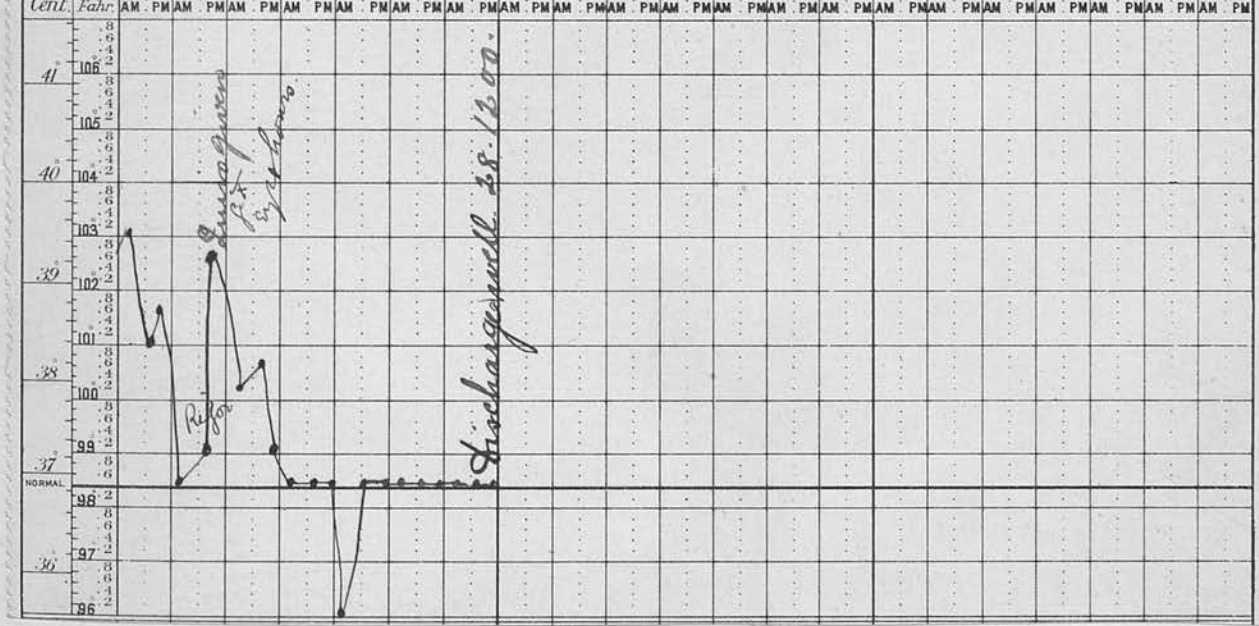
A typical case of benign tertian infection - blood examined during rigor showed sporulating forms. on 25th Dec. spheres present.

NAME. Alboo | RESIDENCE. Toll Gate Boodeloo | AGE. 45 | SEX. M | OCCUPATION. Labourer

DISEASE. Malarial Fever (Benign Double Tertian)

1900 — DATES OF OBSERVATIONS

Dec. 21 22 23 24 25 26 27



A case of tertian infection - double - of red blood corpuscles.

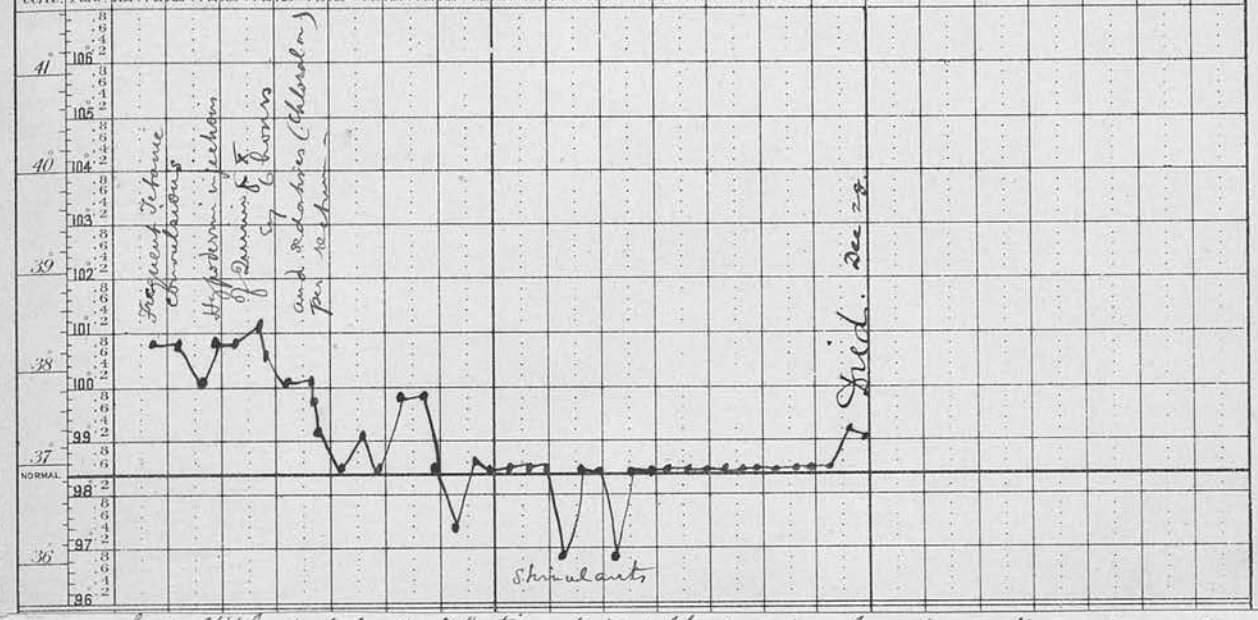
NAME. Arnold Allamby. RESIDENCE. 4th Street Woodbrook. AGE. 17 SEX. M OCCUPATION. Carpenter.

DISEASE. Malarial Fever (Malignant Quotidian) Cerebral (Tetanic)

1900 DATES OF OBSERVATIONS

Dec. 15 16 17 18 19 20 21 22 23 24 25 26 27 28

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM



A case of multiple malignant infection of red blood corpuscles - parasites unpigmented and very small at early stage. Tetanic spasms continued though temperature was not high spasms abated with fall of temperature. Crescents present in abundance. Post mortem examination showed blood of spleen and of cerebral capillaries containing very numerous parasites pigmented and sporulating.

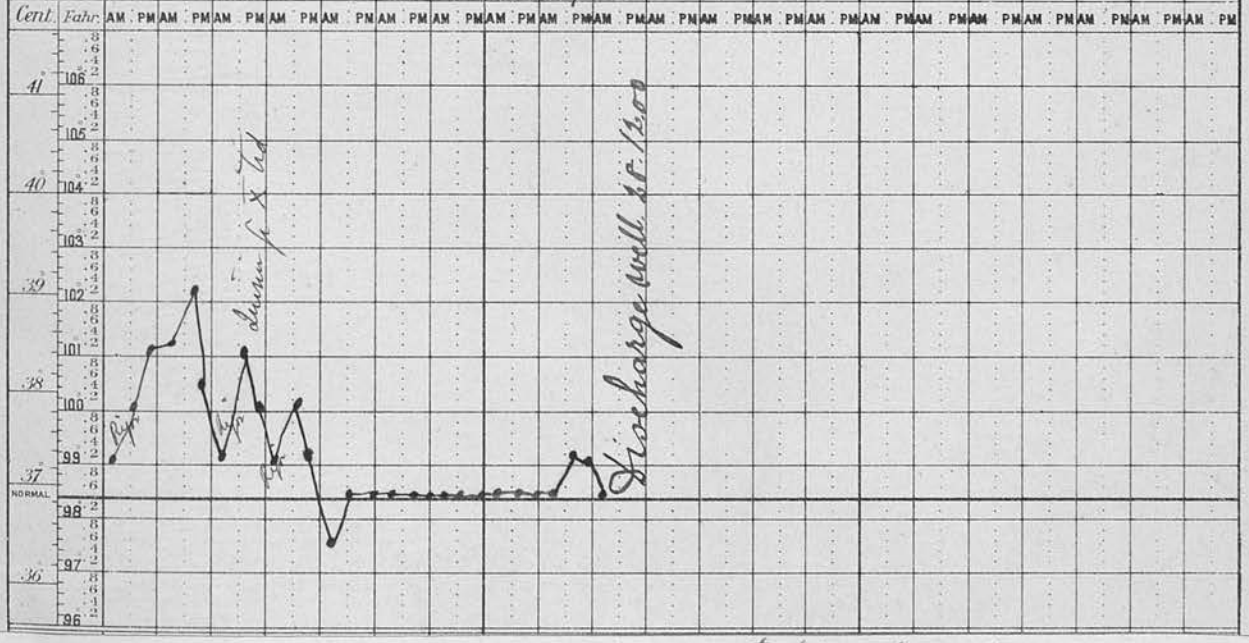
NAME. Arnold Jeremiah RESIDENCE. 25 Quarry Street. AGE. 24 SEX. M OCCUPATION. Baker

DISEASE. Malarial Fever (Benign Double Tertian)

1900 DATES OF OBSERVATIONS

Dec 19 20 21 22 23 24 25 26 27 28

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM



An ordinary case of benign infection (double) with typical parasites

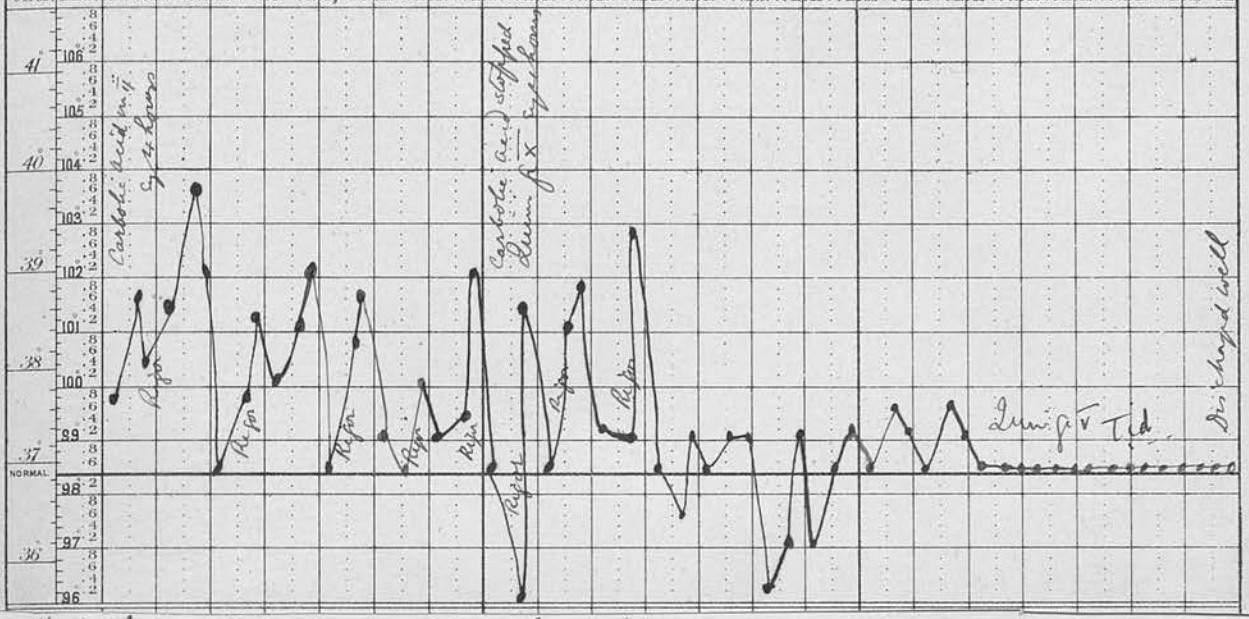
NAME. Charles David | RESIDENCE. 8 St Joseph Road. | AGE. 11 | SEX. M | OCCUPATION. Sch

DISEASE. Malarial Fever (Benign Double Tertian)

1900 — DATES OF OBSERVATIONS

Dec. 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1.1.1/4 2

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM



Multiple infection of red corpuscles with benign tertian parasites. Carbolic acid had no effect: even Quinine was resisted for three days.

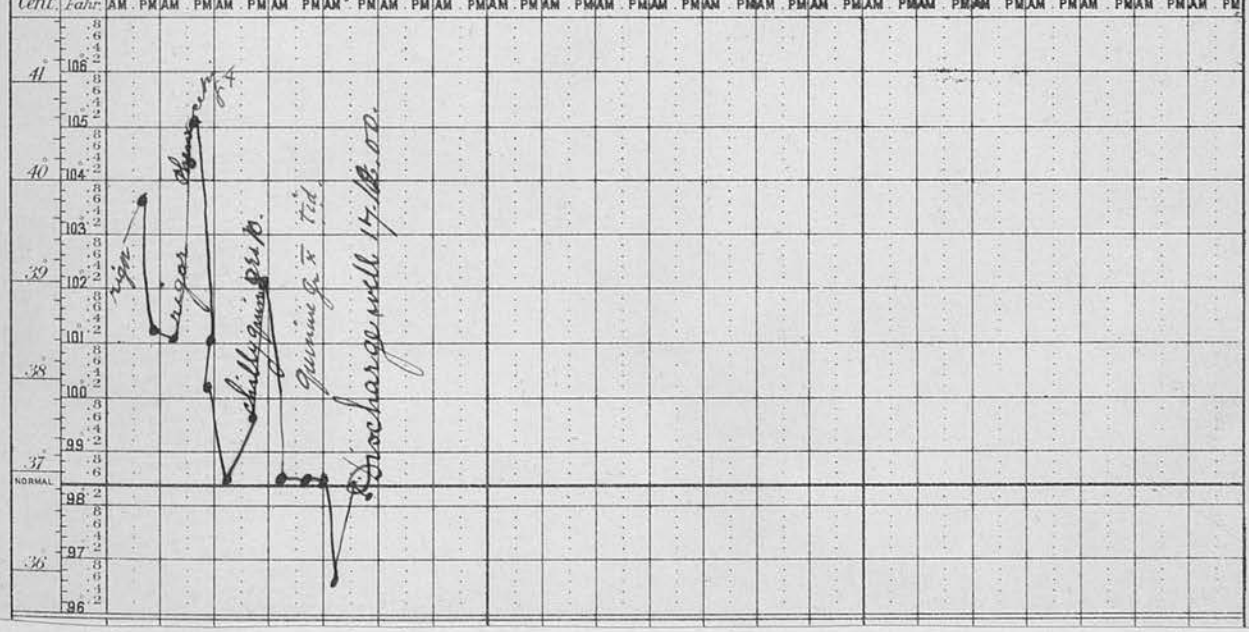
NAME. James Jeffers | RESIDENCE. Excallier's Land. 30 | AGE. 30 | SEX. M | OCCUPATION. Labourer.

DISEASE. Malarial Fever (Benign Double Tertian)

1900 — DATES OF OBSERVATIONS

Dec. 13 14 15 16 17

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM



Blood Examination showed stages of Benign Tertian parasite - Double infection

NAME. Rolly Baptiste. RESIDENCE. 14 A. Nelson Street AGE. 22 SEX. M OCCUPATION. Shipwright

DISEASE. (Fever) Benign Tertian (Double)

1900 DATES OF OBSERVATIONS

Dec. 12 13 14 15 16 17

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM

41 106 40 104 39 102 38 100 37 99 NORMAL 98 36 97 96

Temp. & Quin. 8 grs

Quinine f. x. f.d.

Discharged well 17/12/00.

Typical parasites (Benign Tertian) found. Effect of Quinine well shown.

NAME. Robert Burnett. RESIDENCE. 20 Glossop Lodge AGE. 46 SEX. M OCCUPATION. Cooper

DISEASE. Malarial Fever (Benign Tertian)

1900 DATES OF OBSERVATIONS

Dec 13 14 15 16 17 18 19

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM

41 106 40 104 39 102 38 100 37 99 NORMAL 98 36 97 96

Temp.

Quinine f. x. 4 hrs

Chill

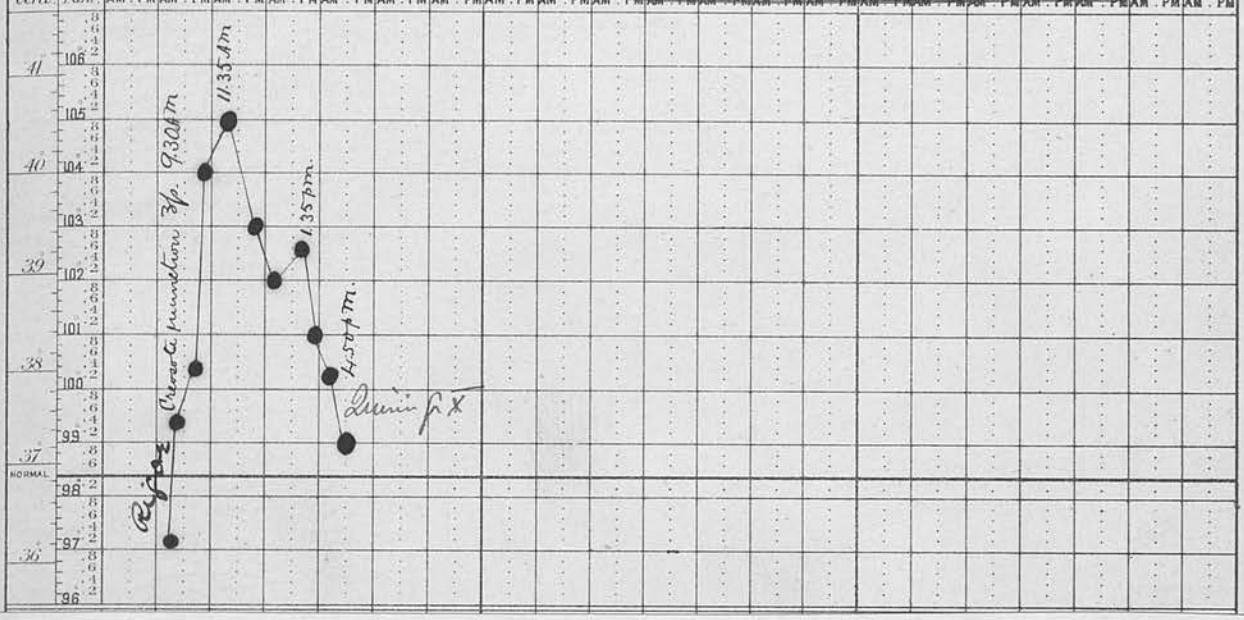
Discharged 19/12/00.

Blood Examination showed Benign Tertian parasite - double infection.

NAME. | RESIDENCE. | AGE. | SEX. | OCCUPATION.

DISEASE. Benign Tertian (Antipyretic Action of Creosote.)

18 DATES OF OBSERVATIONS



Parasite of benign tertian. Injection of Creasote during rigor did not abort rise of temperature

NAME. Antonio Jackson | RESIDENCE. | AGE. | SEX. | OCCUPATION. Labourer

DISEASE. Malignant Quotidian Algide

1899 DATES OF OBSERVATIONS

Oct 10 11 12 13 14 15

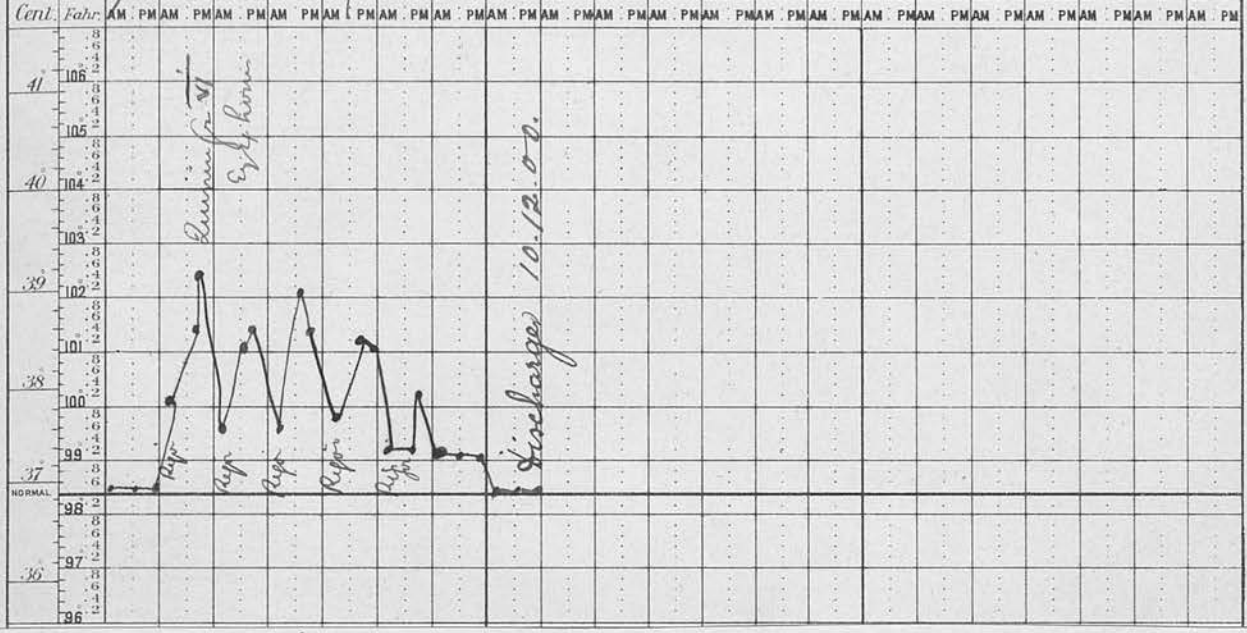
Small unpigmented intra-corpuscular amoeboid forms and crescents. Postmortm - showed pigment in leucocytes, blood corpuscles (red) and other cells in Spleen and Liver which were both enlarged.

NAME. Joseph Knox. RESIDENCE. George Street No 33 AGE. 9. SEX. Bn OCCUPATION. Boil

DISEASE. Anaemia + Malarial Fever (Benign Tertian - double)

1900 DATES OF OBSERVATIONS

3/12 4 5 6 7 8 9 10



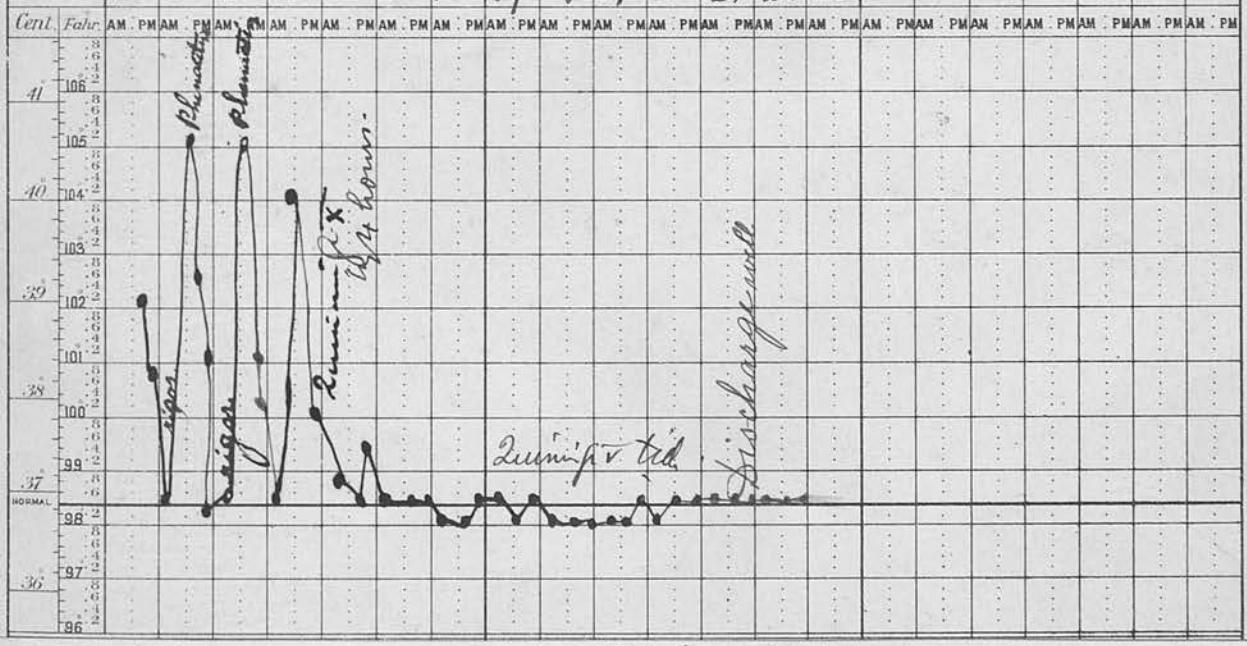
A case of benign tertian in an intensely anaemic boy. Typical parasitic forms found in the blood. Daily paroxysms. Effect of Quinine retarded.

NAME. Charles Roberts RESIDENCE. Woodbrook 2nd Street No 3 AGE. 12 SEX. Bn OCCUPATION. Boil

DISEASE. Malarial Fever (Benign Double Tertian)

1900 DATES OF OBSERVATIONS

Dec. 10 11 12 13 14 15 16 17 18 19 20 21 22 23

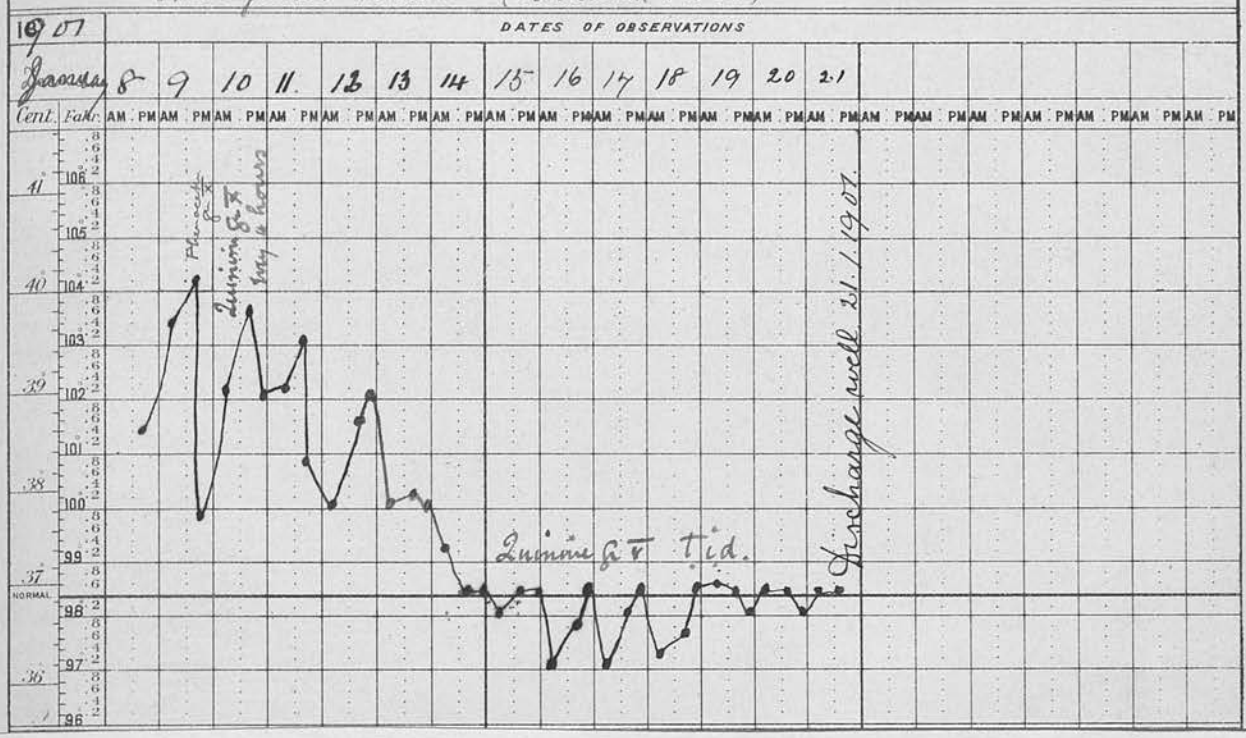


Blood Examination:- double infection with benign Tertian parasites.

NAME. B. Braid | RESIDENCE. 9 St Joseph Road | AGE. 19 | SEX. M | OCCUPATION. Labourer

DISEASE. Malignant Tertian (Malarial Fever)

1907 — DATES OF OBSERVATIONS

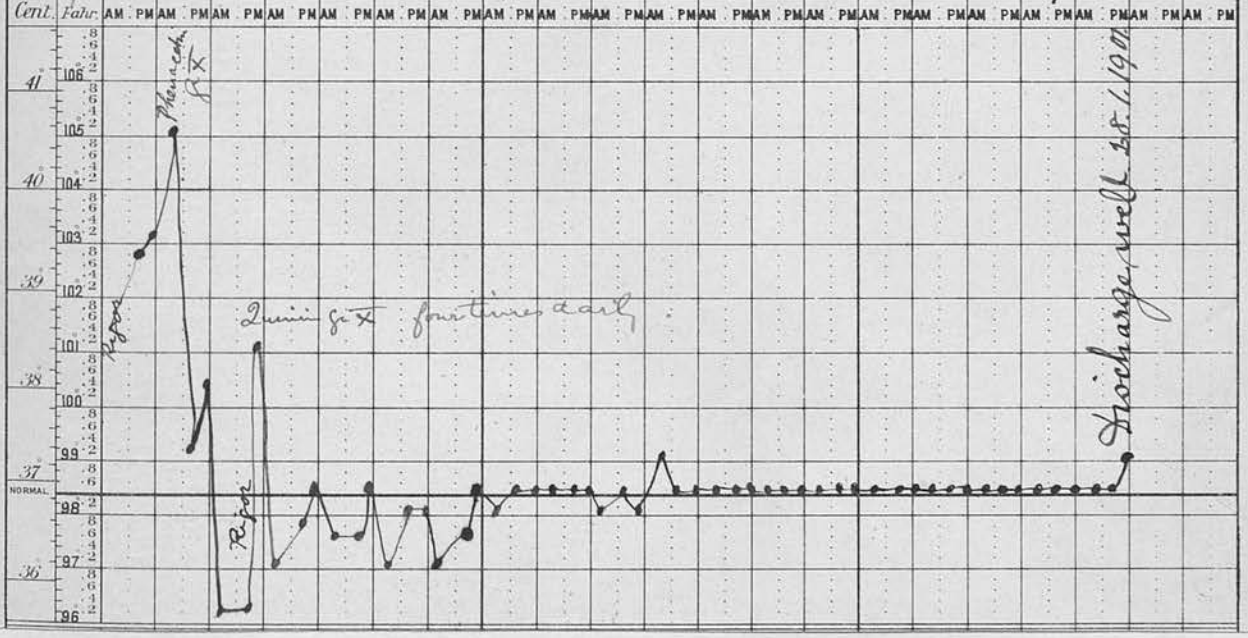


On admission to hospital 8th Jany. Blood Exam. showed young amaboid intra corpuscular forms of malignant tertian parasite. on 13th Jany. Crescents found. No Pyrexia from 15th on 21st Jany. a few crescents observed.

NAME. Charles Norton | RESIDENCE. No 2 East Bank Place | AGE. 30 | SEX. M | OCCUPATION. Overseer

DISEASE. Malarial Fever (Benign Double Tertian)

1907 — DATES OF OBSERVATIONS



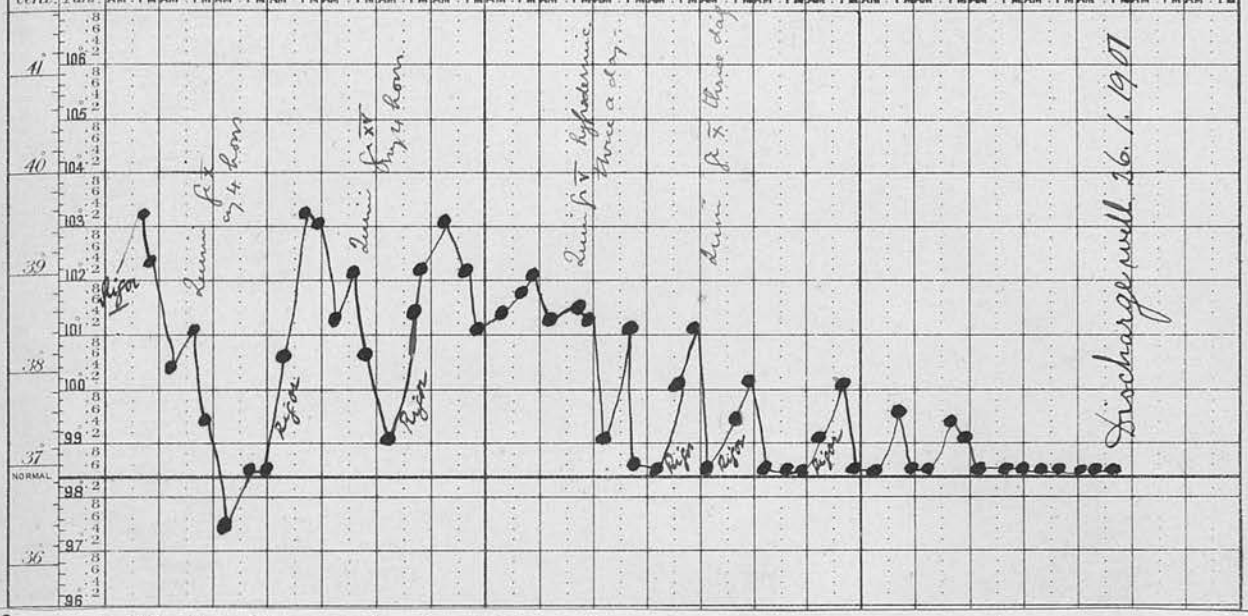
Characteristic Tertian parasites (benign) found in all stages. Chart a-typical on day of discharge from hospital, spheres and pigmented Leucocytes found.

NAME. Unras | RESIDENCE. Chacon St Brodie Hotel | AGE. 29. | SEX. M | OCCUPATION. Labourer.

DISEASE. Malarial Fever (Benign Tertian)

1901 — DATES OF OBSERVATIONS

Jany. 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26



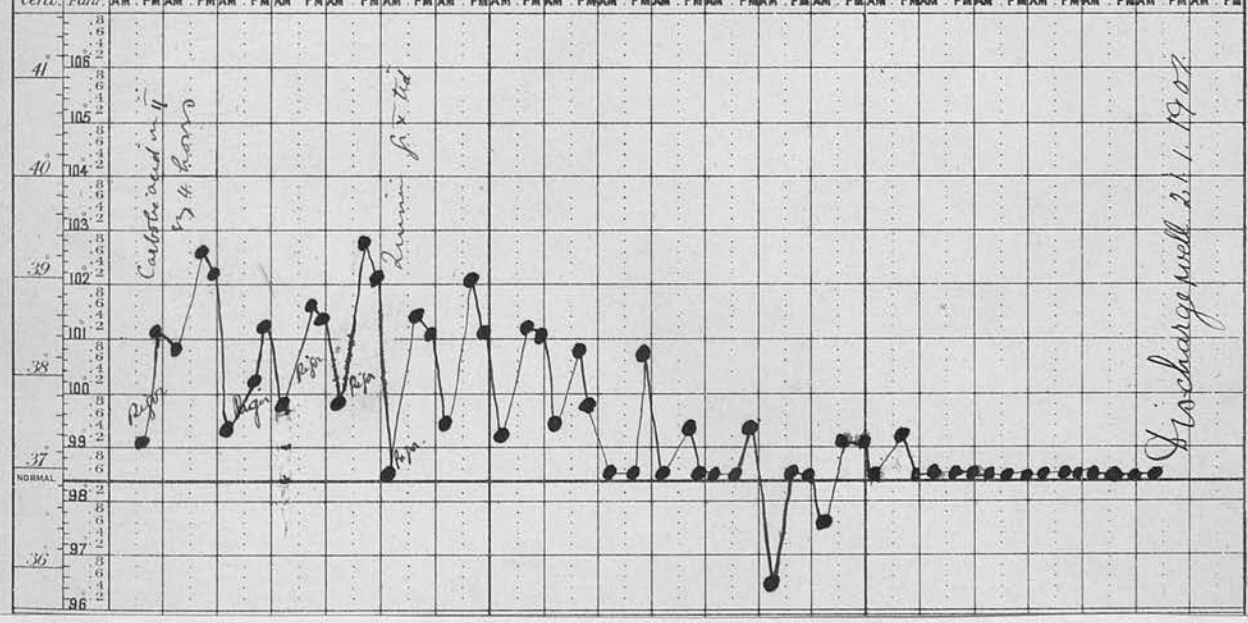
Exam. of Blood: Showed Benign Tertian Parasites numerous. multiple infection in many red corpuscles. also pigmented Leucocytes and later spheres.
observe chart a-typical except 9th to 11th Jany and 19th to 21st Jany.

NAME. T. Scott. | RESIDENCE. 6. Belle Vue St. E.D.R. | AGE. 24 | SEX. M. | OCCUPATION. Labourer

DISEASE. Malarial Fever (Benign Double Tertian)

1901 — DATES OF OBSERVATIONS

Jany. 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22



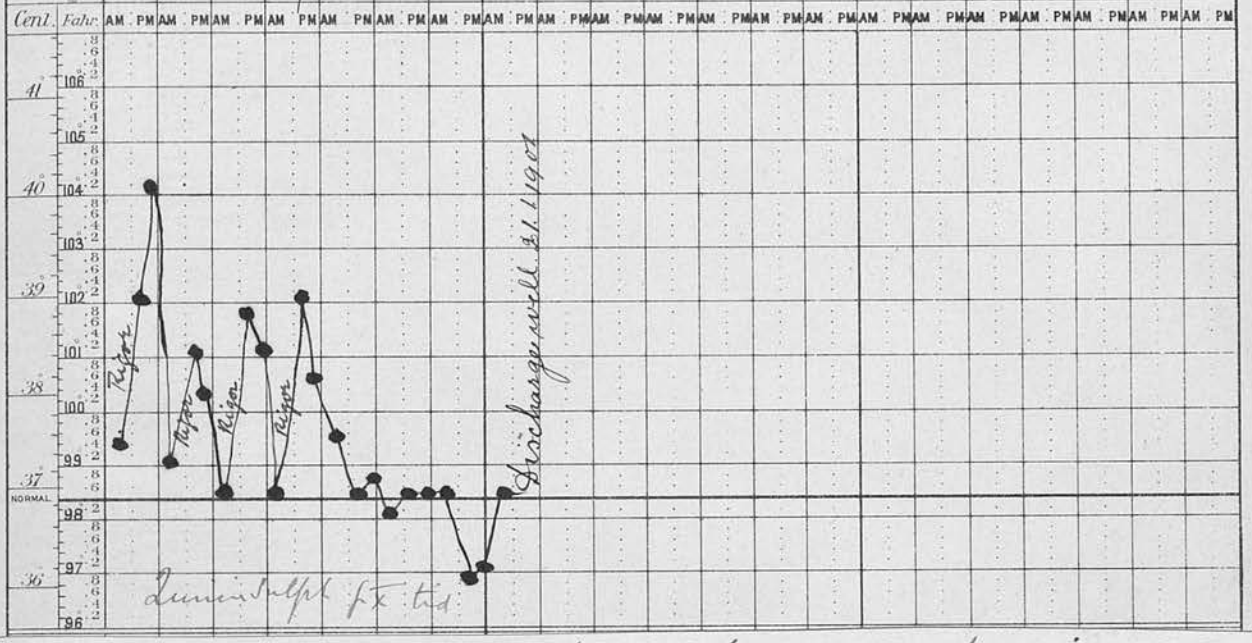
a case of Benign Tertian parasites in blood. pigmented Leucocytes. Carbolic acid no effect for 5 days. Quinine then substituted. Blood free of parasites on discharge.

NAME. Pedro Abadie | RESIDENCE. Hotel Internacional | AGE. 38 | SEX. M | OCCUPATION. Labourer

DISEASE. Malarial Fever (Benign Double Tertian)

1907 — DATES OF OBSERVATIONS

Jany 14 15 16 17 18 19 20 21



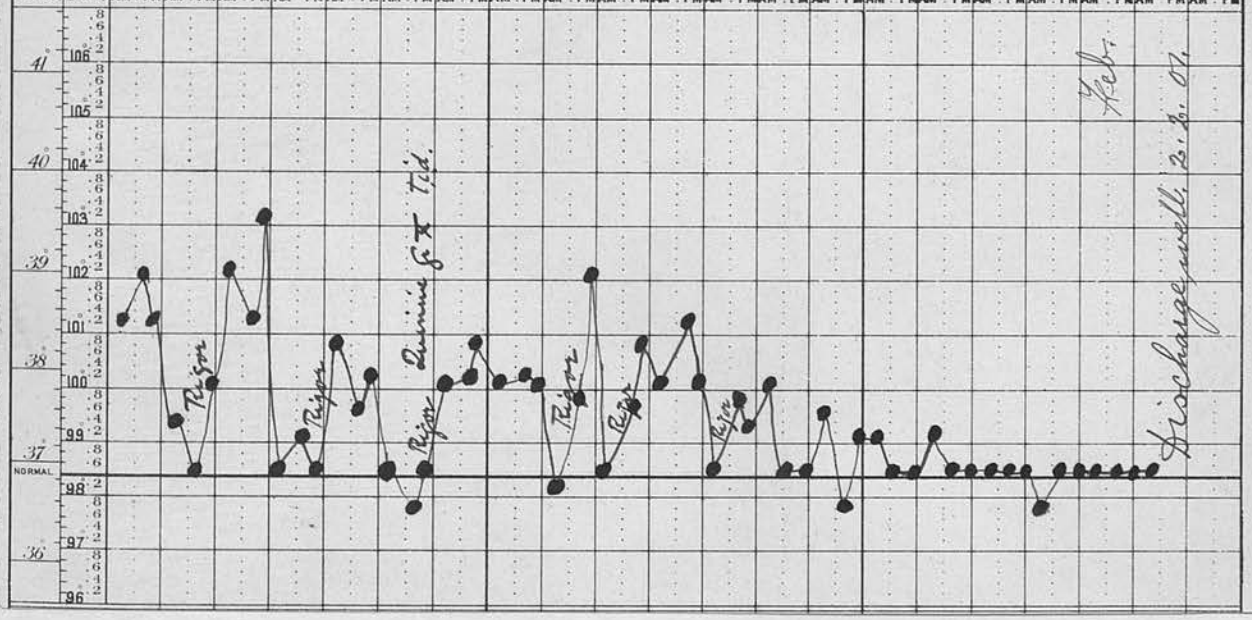
Blood examination showed typical forms of benign tertian parasite. double infection

NAME. Henry Dyer | RESIDENCE. 4 Rose Hill. | AGE. 20 | SEX. M | OCCUPATION. Apprentice Joiner

DISEASE. Malarial Fever (Benign Tertian)

1907 — DATES OF OBSERVATIONS

Jany 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4



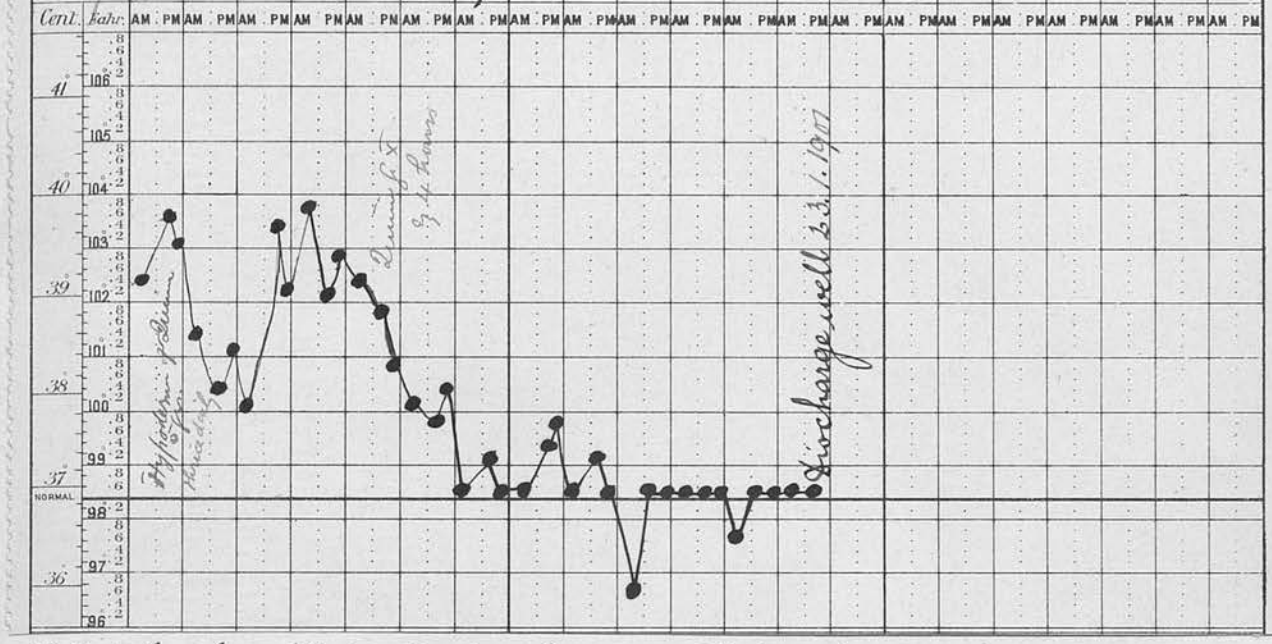
Blood Examination showed benign Tertian parasitic forms. Chart fairly typical up to 21st January.

NAME. Allan Trotman | RESIDENCE. 12 Woodford Street | AGE. 19 | SEX. M | OCCUPATION. Labourer

DISEASE. Malarial Fever (Malignant Tertian)

1901 — DATES OF OBSERVATIONS

Jany 11 12 13 14 15 16 17 18 19 20 21 22 23



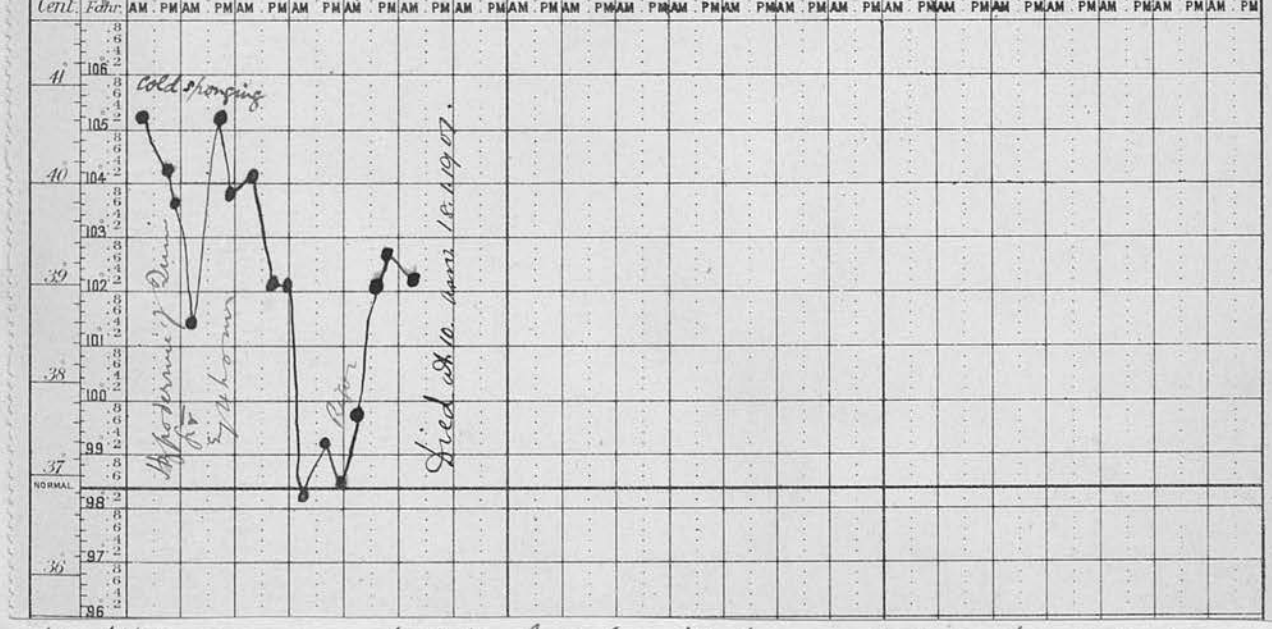
Patient had been ill for ten days before admission. On admission, crescents and pigmented leucocytes found, as well as young amoeboid forms of malignant tertian parasite in the red corpuscles. When discharged, a few crescents present in blood.

NAME. Henry Robert | RESIDENCE. Lower Prince St No 31 | AGE. 45 | SEX. M | OCCUPATION. Ship Carpenter.

DISEASE. Malarial Fever (Malignant Tertian)

1907 — DATES OF OBSERVATIONS

Jany 13 14 15 16 17 18



Admitted in a very weak state; had been ill for 2 weeks prior to admission. Numerous crescents and multiple intra-corpuscular amoeboid forms with pigment, also pigmented leucocytes, found on admission. Did not rally in spite of treatment. Postmortem - showed pigment in leucocytes, in red corpuscles and other cells of spleen and liver.

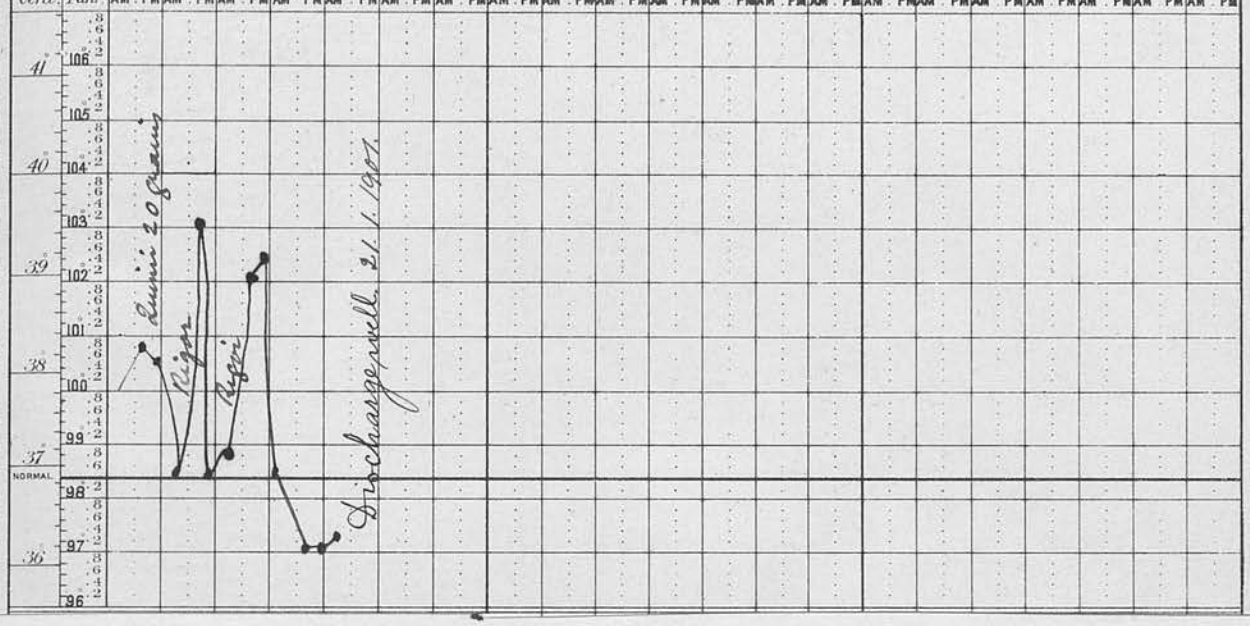
NAME. Edward Hagner | RESIDENCE. Charlotte Street. | AGE. 37 | SEX. M | OCCUPATION. Coach Builder

DISEASE. Malarial Fever (Benign Double Tertian)

1907 — DATES OF OBSERVATIONS

Jany 17 18 19 20 21

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM



Blood Examination showed benign tertian parasite in all stages.
Quinine 20 grs. in Sweating stage. and 10 grains thrice daily afterwards.

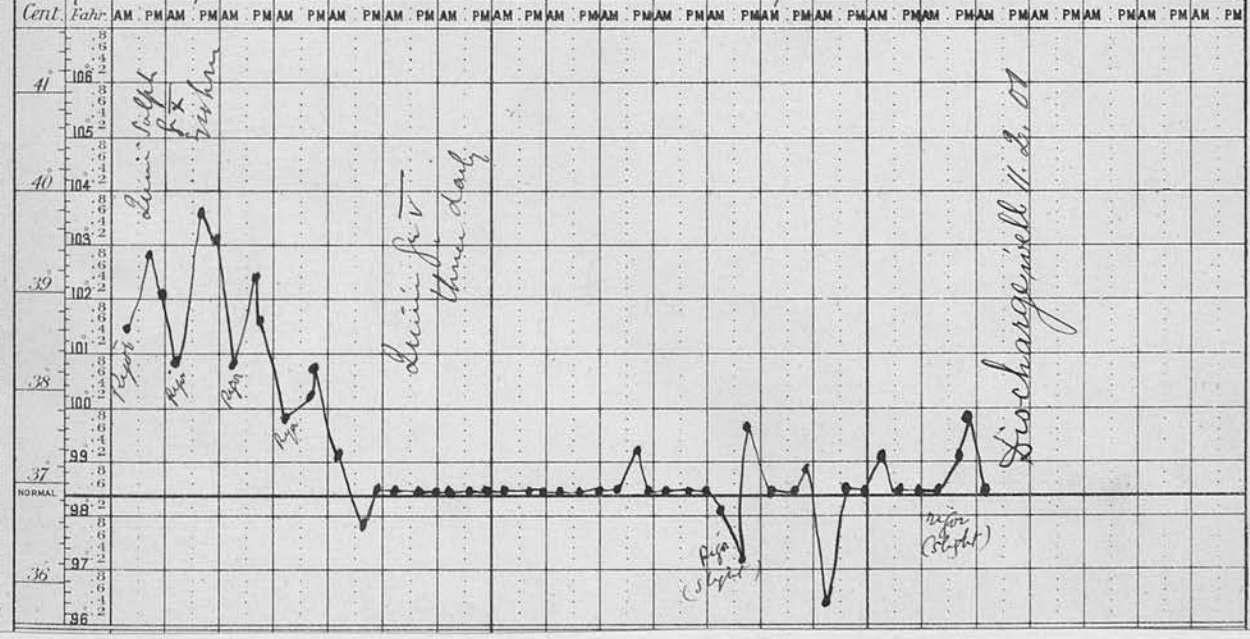
NAME. Charles Henry Risto. | RESIDENCE. | AGE. 15 | SEX. M | OCCUPATION. Bil

DISEASE. Malarial Fever. (Benign Tertian)

1907 — DATES OF OBSERVATIONS

Jany 26 27 28 29 30 31 1.2 2 3 4 5 6 7 8 9 10 11

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM



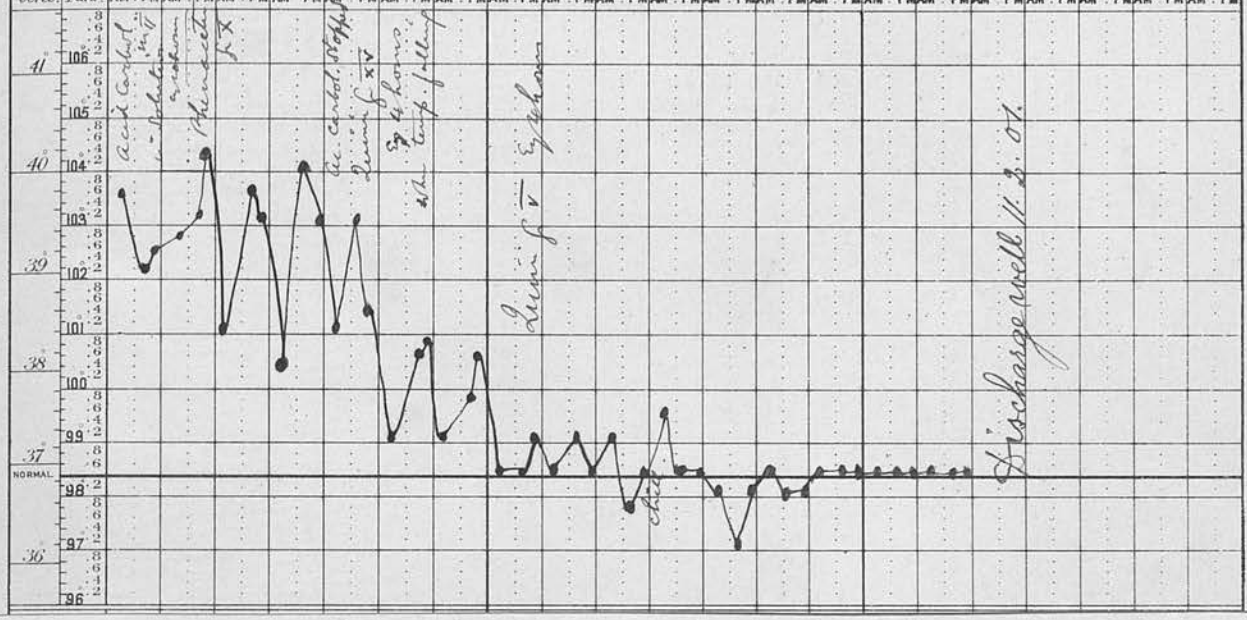
A case of multiple infection with benign tertian parasites. Intra-corpuscular amoeboid forms present as well as spheres (gametes)
Observe slight paroxysms on 6th and 10th Feby. in spite of Quinine.

NAME. James Clarke | RESIDENCE. 9 St Joseph Road. | AGE. 28 | SEX. M | OCCUPATION. Labourer.

DISEASE. Malarial Fever (Malignant Tertian)

1907. DATES OF OBSERVATIONS

Jany 26 27 28 29 30 31 1.2.07 3 3 4 5 6 7 8 9 10



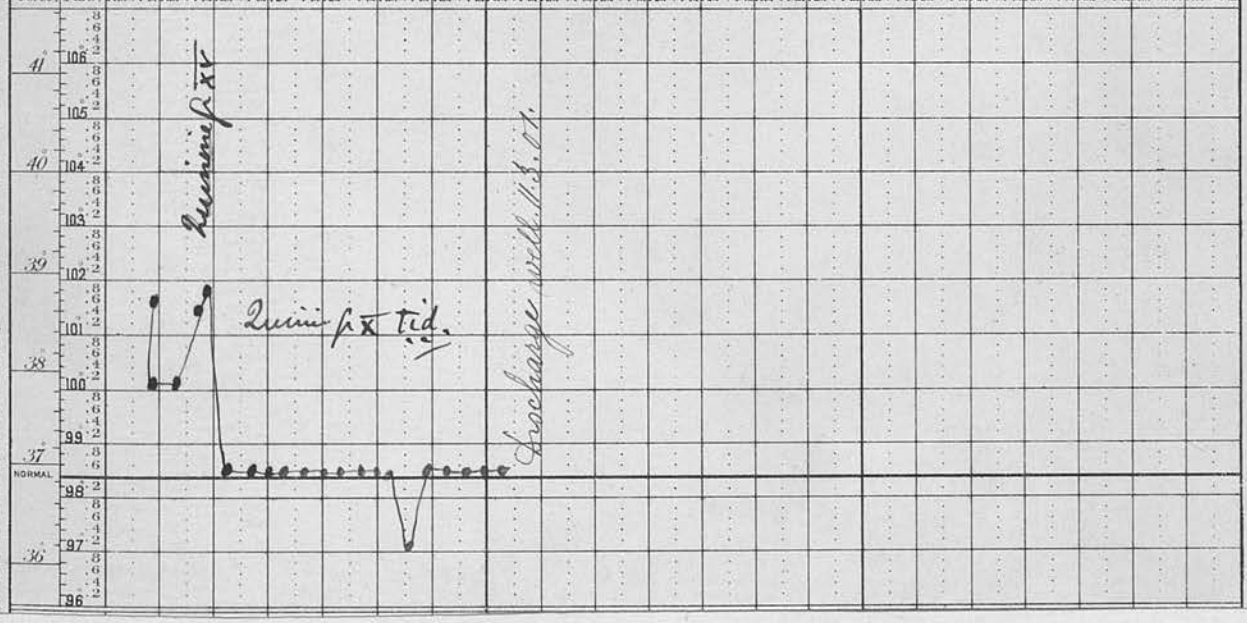
Blood Examination :- infection with malignant tertian parasites - characteristic forms and stages seen. a few crescents persisted on 11th Feby. when discharged.
Observe chill and slight rise of temperature on 5th February.

NAME. A. Sharpe. | RESIDENCE. Sussex Street & Ave | AGE. 21 | SEX. M | OCCUPATION. Clerk.

DISEASE. Malarial Fever (Benign Tertian)

1907 DATES OF OBSERVATIONS

March 4 5 6 7 8 9 10 11

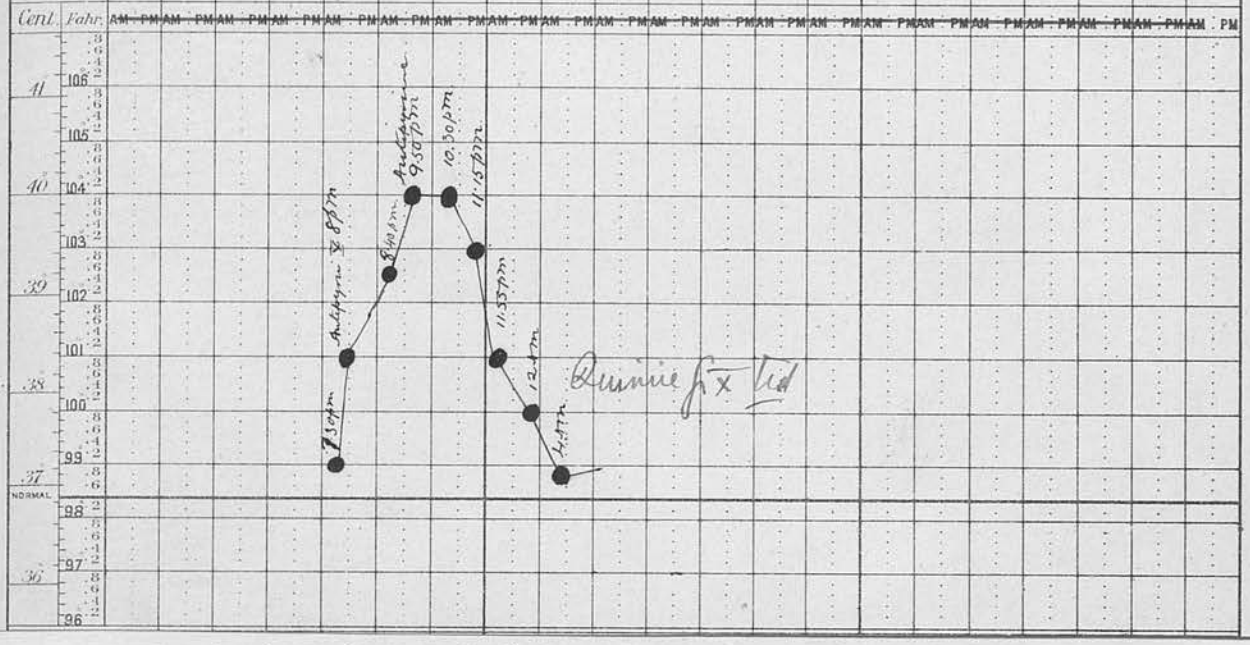


Blood Examination :- intra-corpuscular forms of Tertian parasite (benign) on March 4th
" " on 8th March :- gametes or free spherical forms and pigmented leucocytes
" " on 11th " :- no parasitic forms seen.

NAME. | RESIDENCE. | AGE. | SEX. | OCCUPATION.

DISEASE. Benign Tertian - Antipyrine as an Antipyretic

18 DATES OF OBSERVATIONS

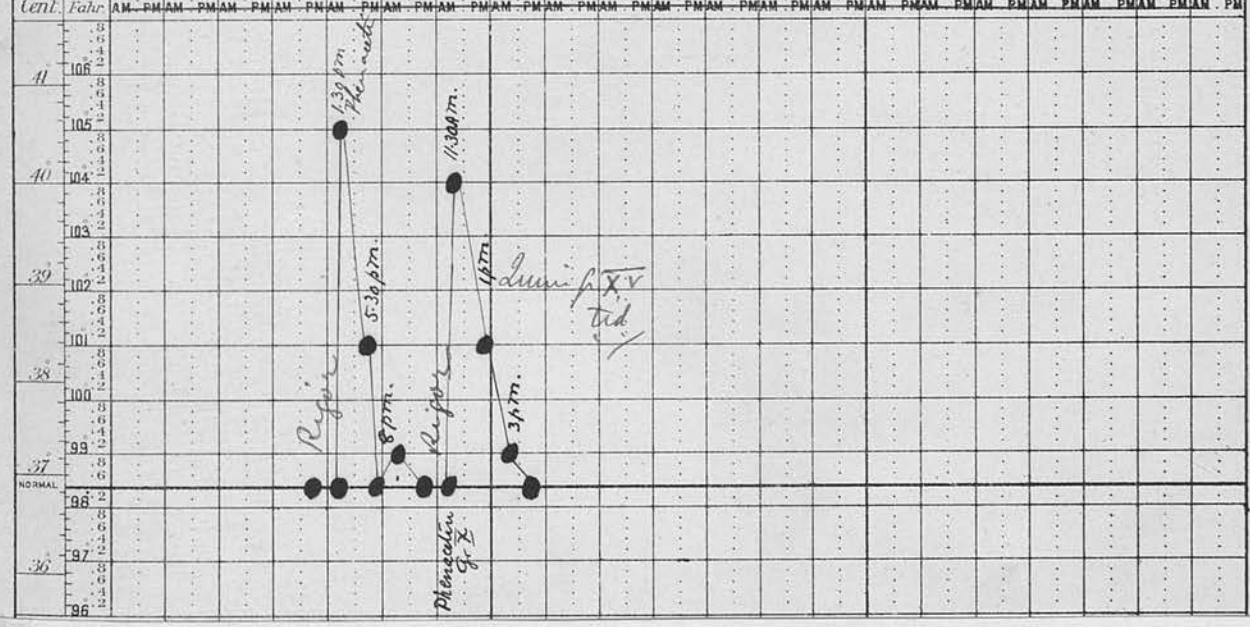


Benign Tertian parasites. Antipyrin during rigor did not abort rise of temperature.

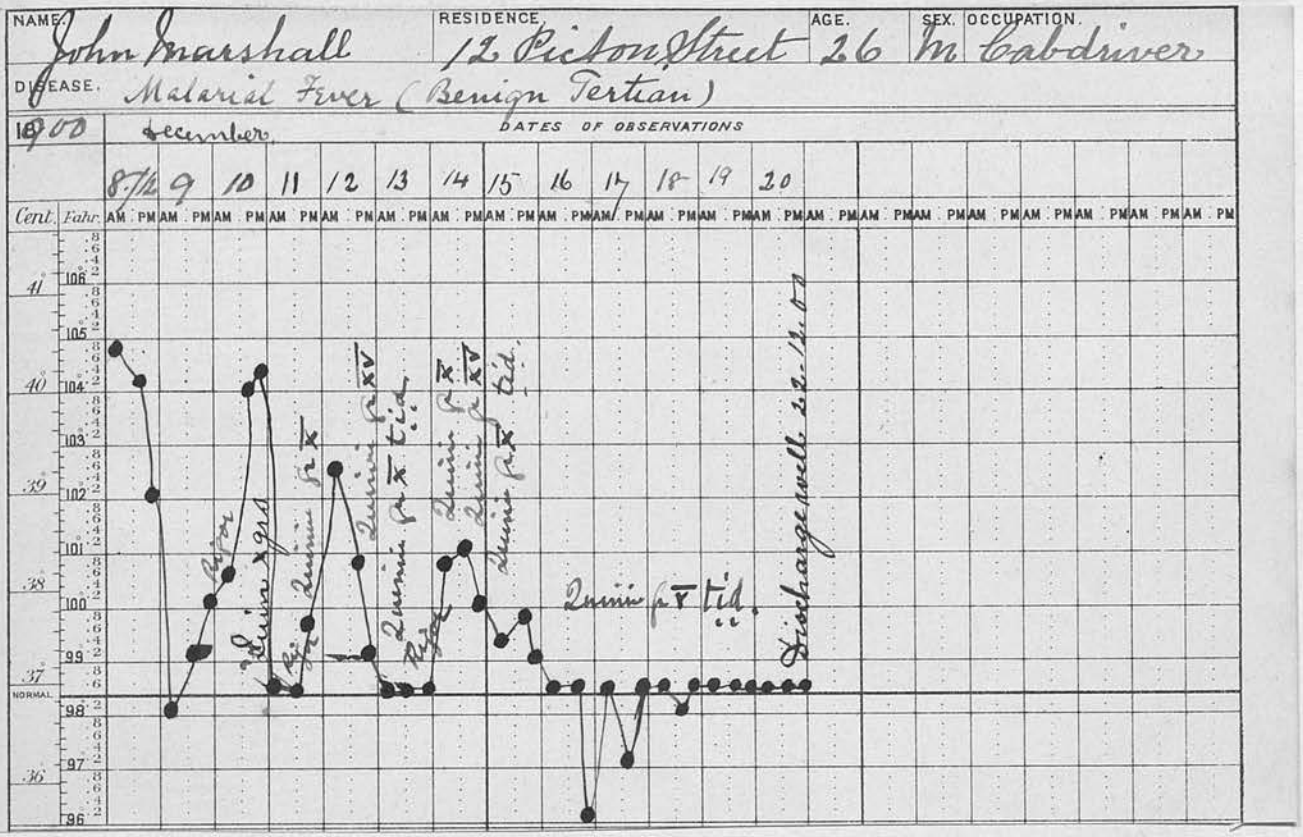
NAME. J. R. | RESIDENCE. | AGE. | SEX. | OCCUPATION.

DISEASE. Benign Tertian. (Antipyretic action of Phenacetin)

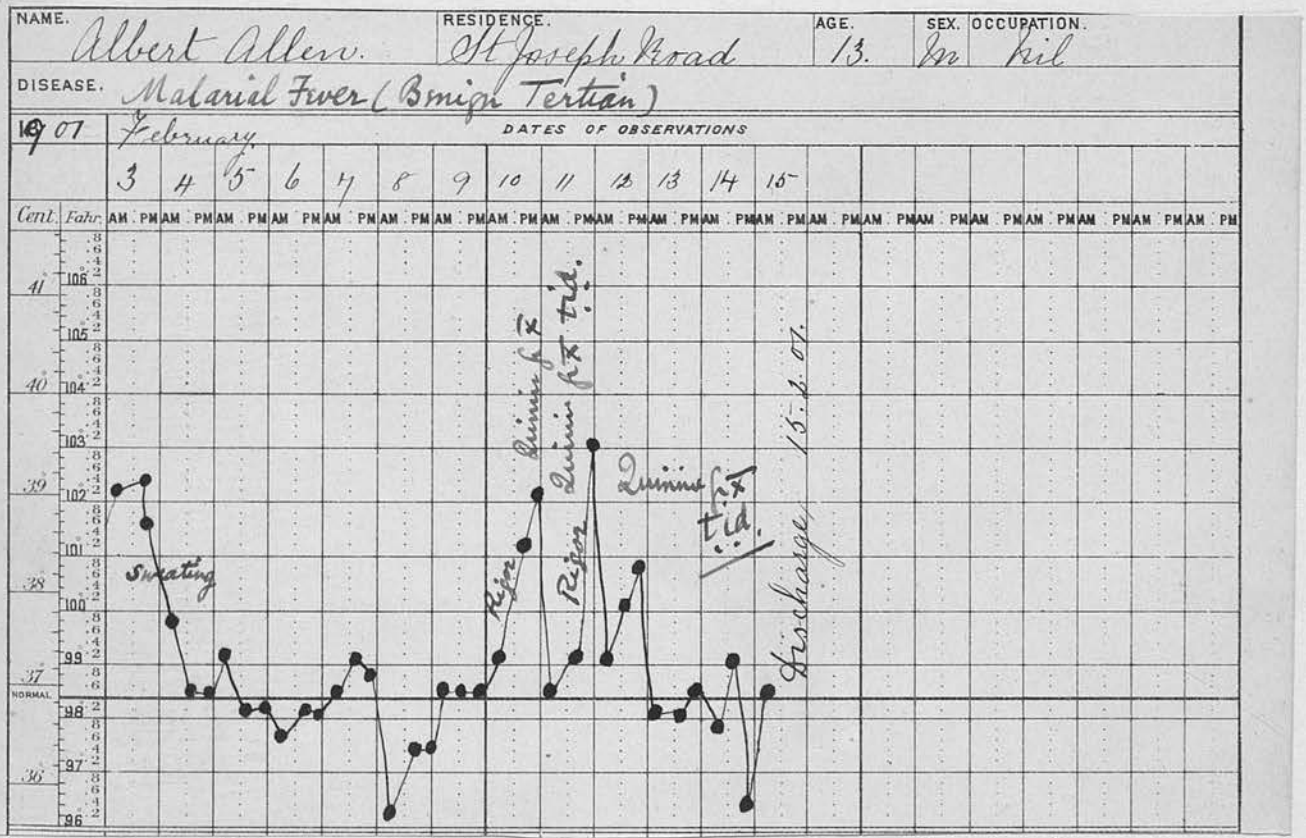
18 DATES OF OBSERVATIONS



Blood examination showed typical benign parasites (Tertian). Antipyretic action of Phenacetin marked. Phenacetin given at rigor, did not abort rise of temperature



A typical case of Benign Tertian infection showing characteristic parasites in blood.



Examination of blood on admission showed typical benign tertian parasites, just after sporulation. No Quinine was administered. Temp. went down. Paroxysms very slight on 5th and 7th February. Parasites present in blood still. Quinine administered after paroxysm on 10th and t.i.d. on 11th. Blood free of parasites on 15th. Few pigmented

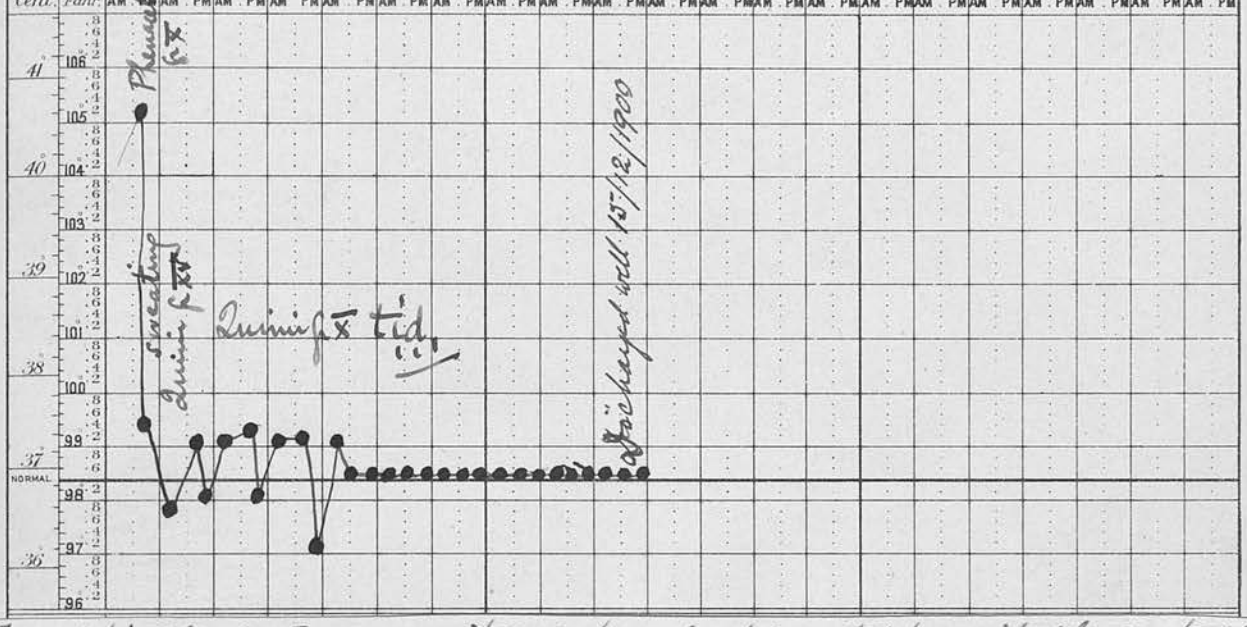
NAME. E. Gamboa | RESIDENCE. 31 Duke Street | AGE. 21 | SEX. M | OCCUPATION. Clerk

DISEASE. Malarial Fever (Benign Double Tertian)

1900 Dec. DATES OF OBSERVATIONS

4 5 6 7 8 9 10 11 12 13

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM



Examination of blood:- Numerous intra-corpuscular pigmented parasites (benign tertian) multiple infection - Paroxysms kept in check by Quinin. Sulphat.

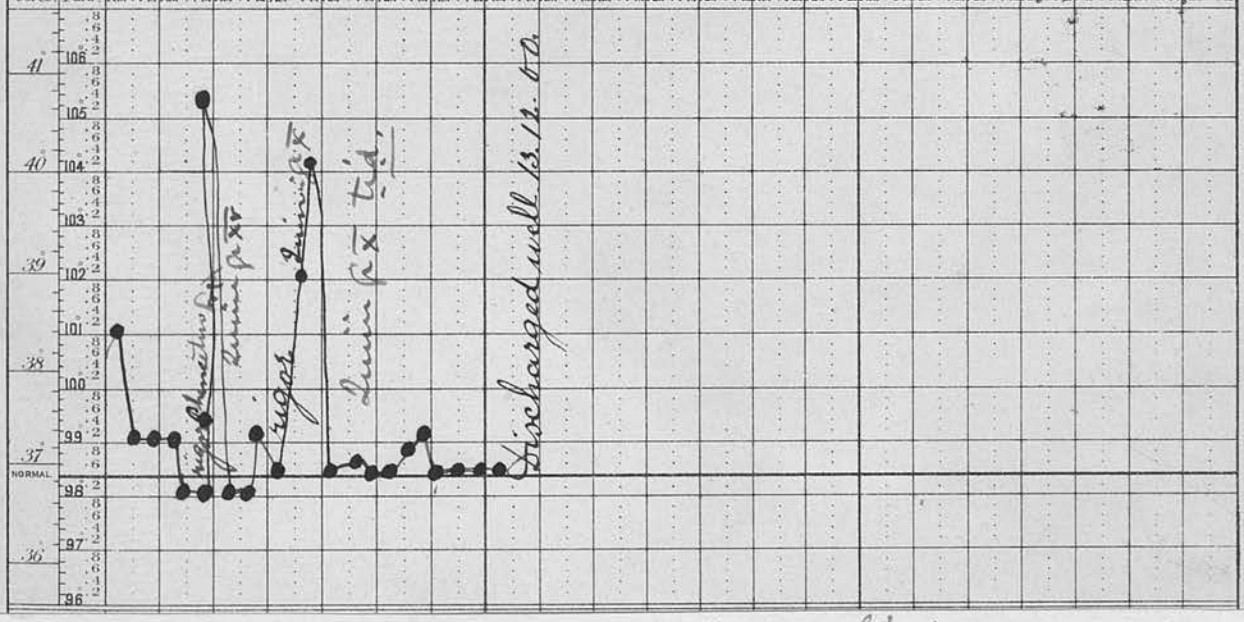
NAME. David Howe | RESIDENCE. No 6 Cipriani Boulevard | AGE. 19 | SEX. M | OCCUPATION. Platman

DISEASE. M. Fever (Benign Tertian)

1900 DATES OF OBSERVATIONS

Dec. 6 7 8 9 10 11 12 13

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM



Typical case of Benign Tertian infection - blood appearances characteris

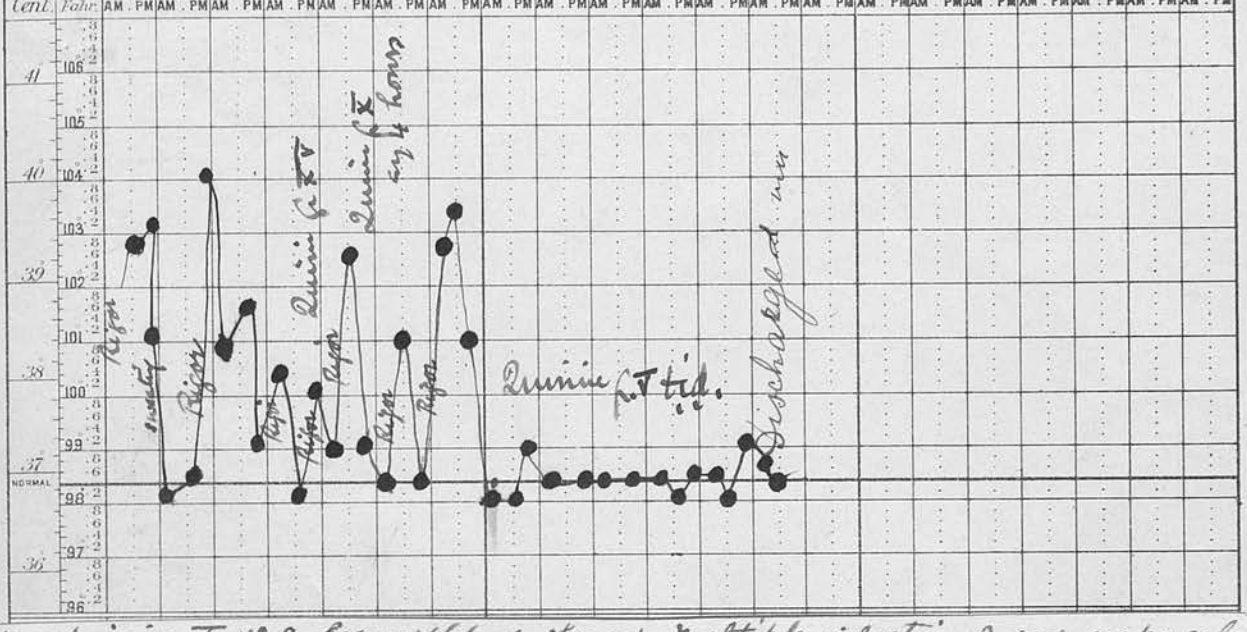
NAME. Gilbert Dieffenthalle RESIDENCE. South Quay Extension Go 111 AGE. 16 SEX. OCCUPATION. In Blacksmiths

DISEASE. Malarial Fever (Benign Double Tertian)

1900 DATES OF OBSERVATIONS

Dec[r] 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM



On admission T. 102.8, Exam: of blood showed multiple infection of red corpuscles with benign tertian parasite - Some very young amoeboid forms seen near corpuscles, apparently the result of recent segmentation and division - Quinine Sulph. begun on 12th Dec[r] — Observe almost two Paroxysms in one day on 12th and 13th.

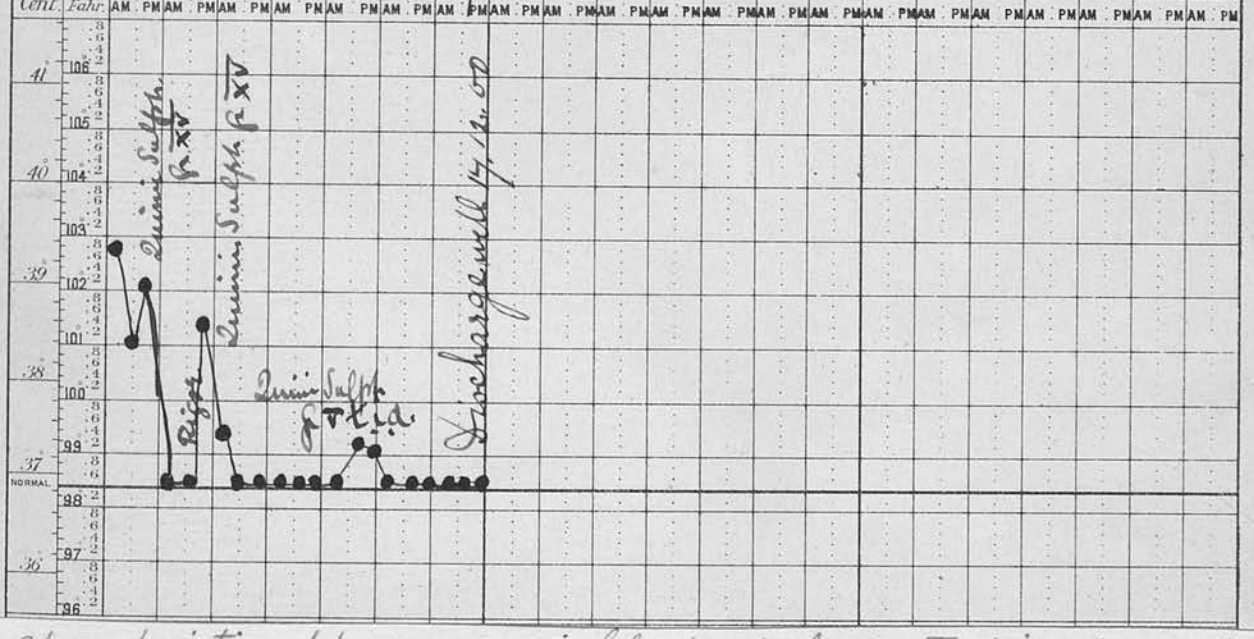
NAME. J. Bernard RESIDENCE. Greenhill Village Diggs AGE. 26 SEX. OCCUPATION. M. Labourer

DISEASE. Malarial Fever (Benign Tertian)

1900 DATES OF OBSERVATIONS

Dec 11 12 13 14 15 16 17

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM



Characteristic appearances in blood of benign Tertian infection.

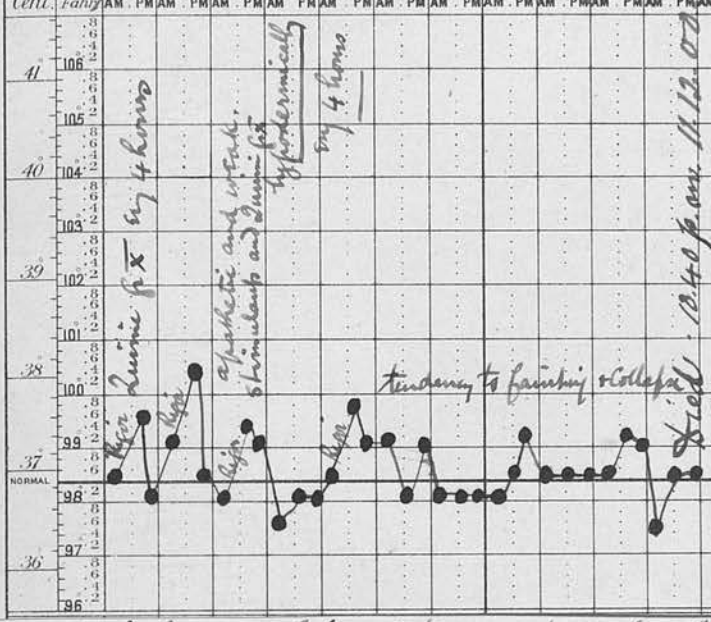
NAME. J. Payne | RESIDENCE. No 10 Prince St West. | AGE. 21 | SEX. M | OCCUPATION. Seaman.

DISEASE. Malarial Fever (Malignant Tertian) Algide

1900 — DATES OF OBSERVATIONS

Dec 1/12 2 3 4 5 6 7 8 9 10 11

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM



On admission amaboid intra-corpuscular formes of Malignant Tertian parasite as well as Crescents. In spite of Quinine general condition did not improve, though parasites seemed to diminish. Observe tertian character 3½ to 5½; 6½ to 8½; 8½ to 10½. Postmortem: showed pigmented cells and leucocytes in liver and Spleen.

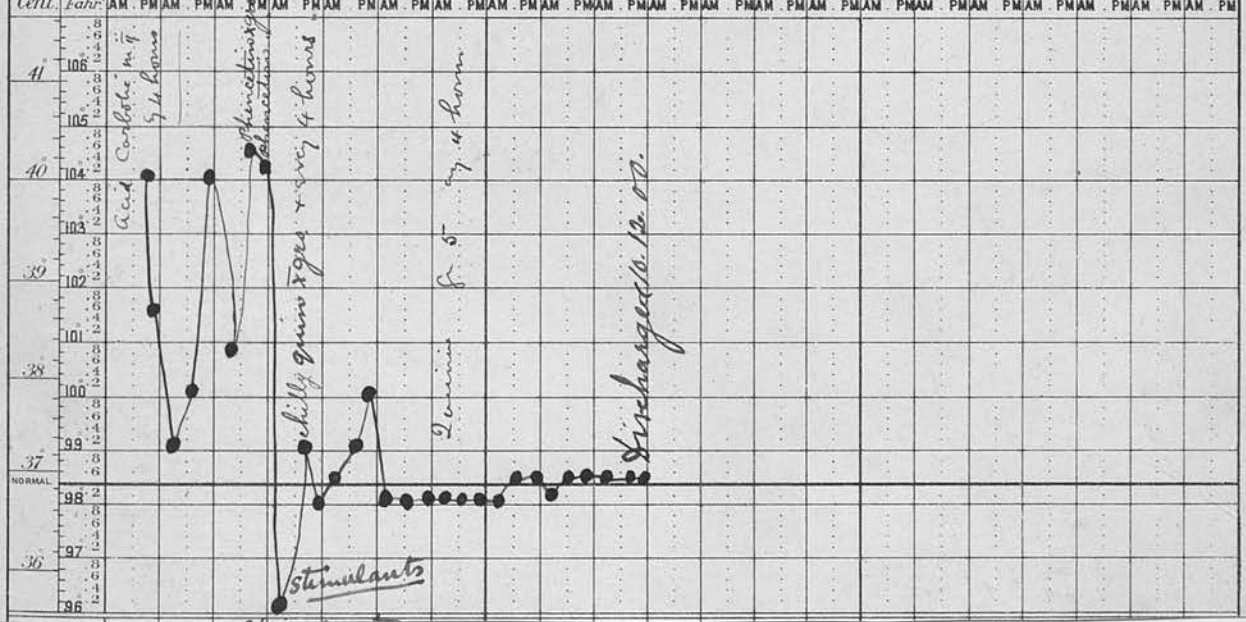
NAME. L. Graves | RESIDENCE. New Town Gray St North | AGE. 22 | SEX. M | OCCUPATION. Labourer

DISEASE. M. Fever (Benign Double Tertian)

1900 — DATES OF OBSERVATIONS

1/12 2 3 4 5 6 7 8 9 10 11

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM



Double infection of corpuscles with Benign Tertian parasite. Observe Sudden fall of Temperature after Phenacetin and State of semi-collapse. Acid Carbolic useless.

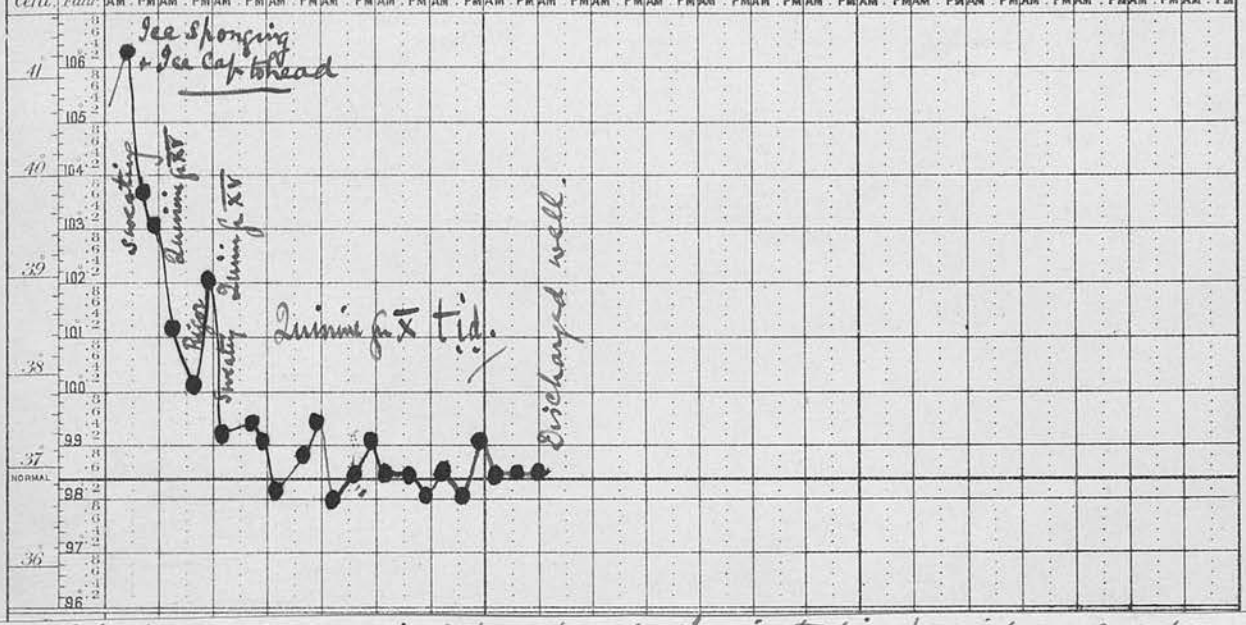
NAME. Moorhar | RESIDENCE. Vagrant | AGE. 42 | SEX. M | OCCUPATION. Labourer.

DISEASE. Benign Tertian (on Adm.) Malarial Fever.

1900 November — DATES OF OBSERVATIONS

5 6 7 8 9 10 11 12

Cent. / Fahr. — AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM



Amaboid forms numerous in red corpuscles, (benign tertian parasite) - Some pigmented leucocytes (mononucleated) and Spheres with pigment. Observe Rigor on 6th Nov. before fall of Temp. to normal after previous paroxysm.

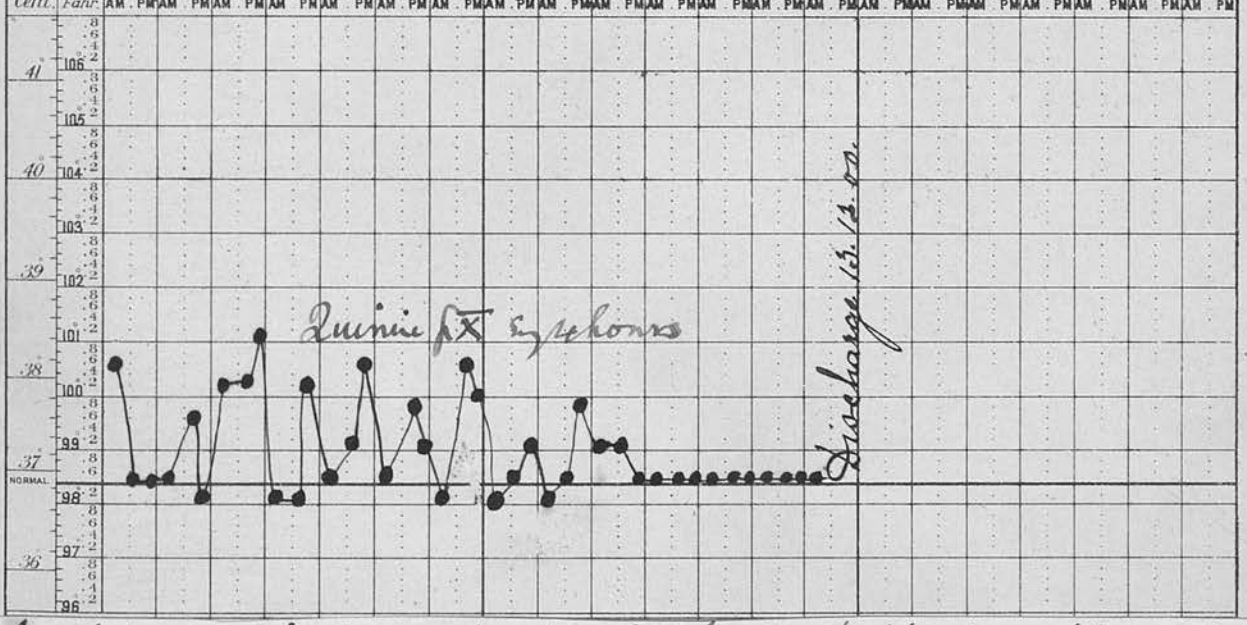
NAME. E. Jones | RESIDENCE. 31 Maraval Road. | AGE. 24 | SEX. M | OCCUPATION. Labourer.

DISEASE. M. Fever (Benign Tertian)

1900 — DATES OF OBSERVATIONS

Nov 30 Dec 1/12 2 3 4 5 6 7 8 9 10 11 12 13

Cent. / Fahr. — AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM



Multiple infection of red corpuscles with benign tertian parasite giving daily paroxysms.

NAME. Sams | RESIDENCE. Escallier Lel. | AGE. 36 | SEX. M | OCCUPATION. Labourer

DISEASE. Malarial Fever (Benign Tertian)

1907 — DATES OF OBSERVATIONS

Feby. 17 18 19 20 21 22

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM

41° 106 · 40° 104 · 39° 102 · 38° 100 · 37° NORMAL 98 · 36° 97 · 96

Quinine Sulph gr XV

Quinine Sulph gr X

Quinine Sulph gr XV

Quinine gr X

Quinine gr X every 4 hours

Rigor

Rigor

Rigor

Rigor

Discharged well

A case of multiple infection - Parasites very numerous - daily paroxysms, each starting before completion of previous paroxysm. Quinine begun on 19th —

NAME. Joseph Harrimson | RESIDENCE. Woodbrook 2 Main St | AGE. 29 | SEX. M. | OCCUPATION. Baker

DISEASE. Malarial Fever (Benign Tertian)

1900 — DATES OF OBSERVATIONS

Dec 2 19 20 21 22 23 24 25

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM

41° 106 · 40° 104 · 39° 102 · 38° 100 · 37° NORMAL 98 · 36° 97 · 96

Quinine gr XX

Quinine gr X

Quinine gr XX

Rigor

Rigor

Quinine gr X every 4 hours

Discharged well

A typical case in which the examination of the blood showed double infection. Effect of large doses of Quinine is marked.

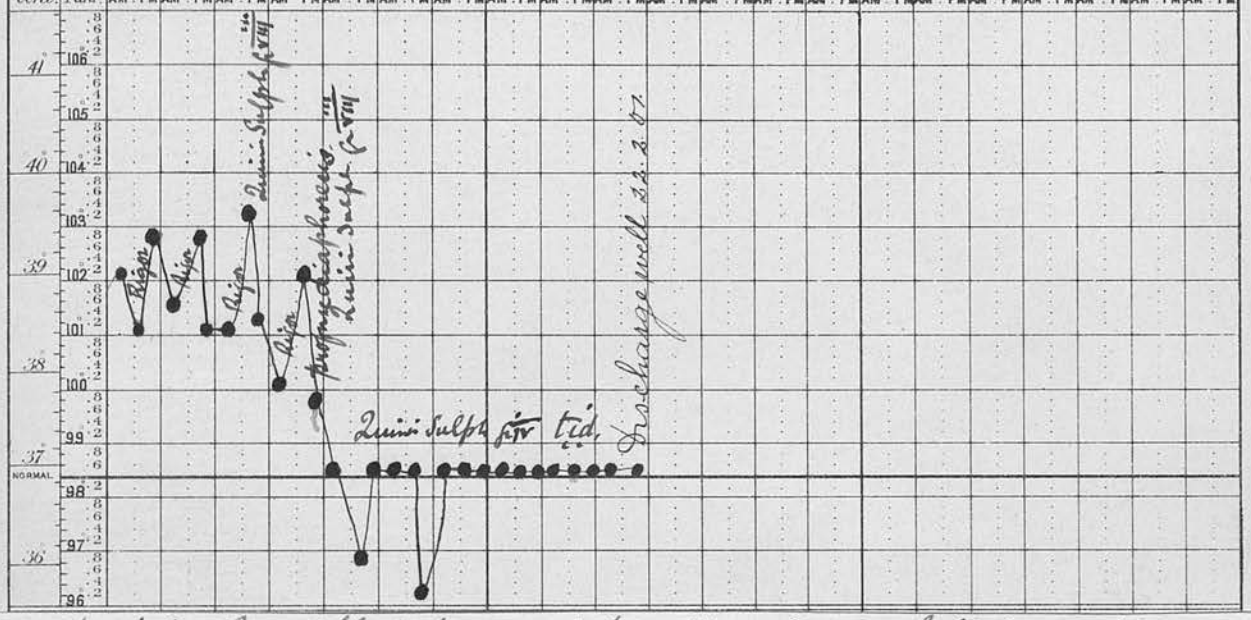
NAME. Alfred Hann. RESIDENCE. North Street 40 AGE. 7 SEX. M OCCUPATION. Sail

DISEASE. Malarial Fever (Malignant Quotidian)

1907 DATES OF OBSERVATIONS

Feby. 13 14 15 16 17 18 19 20 21 22

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM



On admission:- Exam of blood showed minute unpigmented amoeboid forms in red corpuscles. These developed very fine pigment. Crescents on 16th Feby. No special symptoms save extreme "weakness and "typhoid" condition.

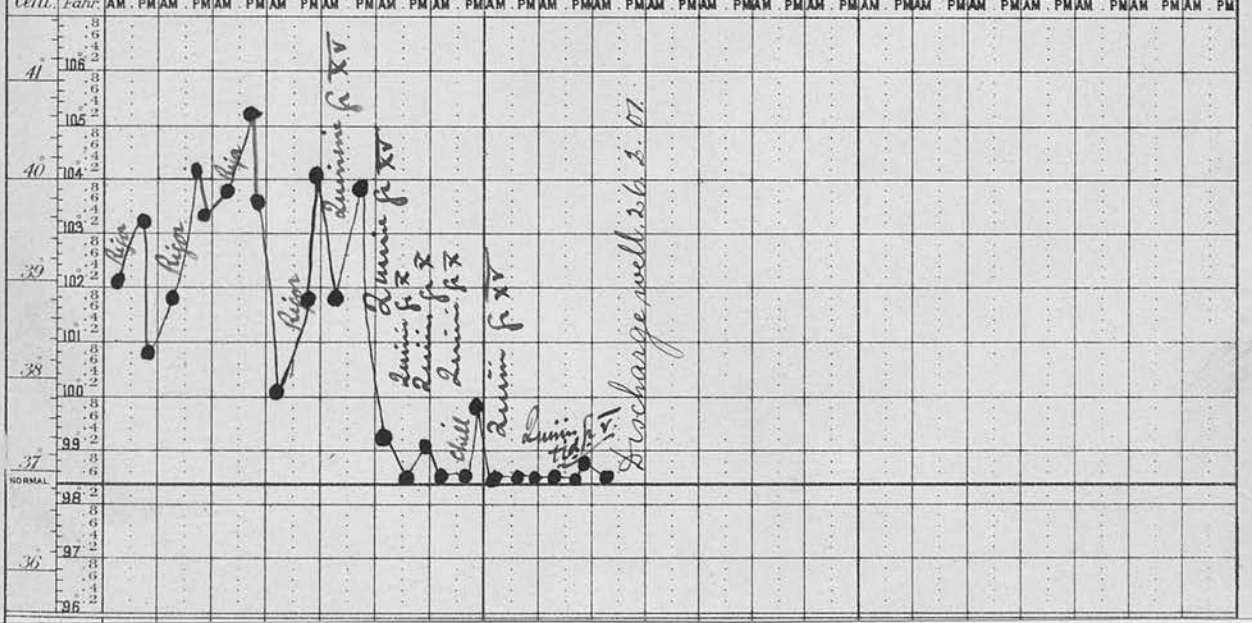
NAME. E. Ford. RESIDENCE. Cambridge Street AGE. 28 SEX. M. OCCUPATION. Mason.

DISEASE. Malarial Fever (Benign Tertian)

1907 DATES OF OBSERVATIONS

Feby 17 18 19 20 21 22 23 24 25 26

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM



Benign Tertian parasites in various stages seen in blood - daily paroxysms due to multiple infection.

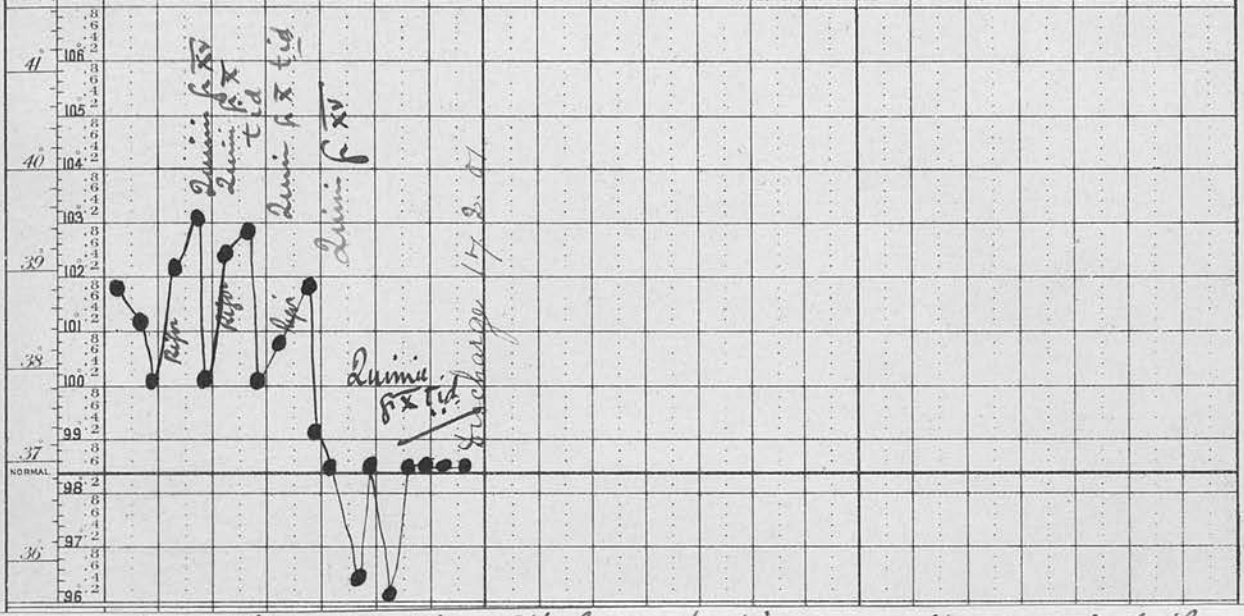
NAME. Ramoo. RESIDENCE. Charlotte Street. AGE. 60 SEX. M OCCUPATION. Labourer

DISEASE. Malarial Fever (Benign Tertian)

1907 DATES OF OBSERVATIONS

Feby. 11 12 13 14 15 16 17

Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM



A case of multiple infection with benign tertian parasites, giving daily paroxysms which yield to Quinine.

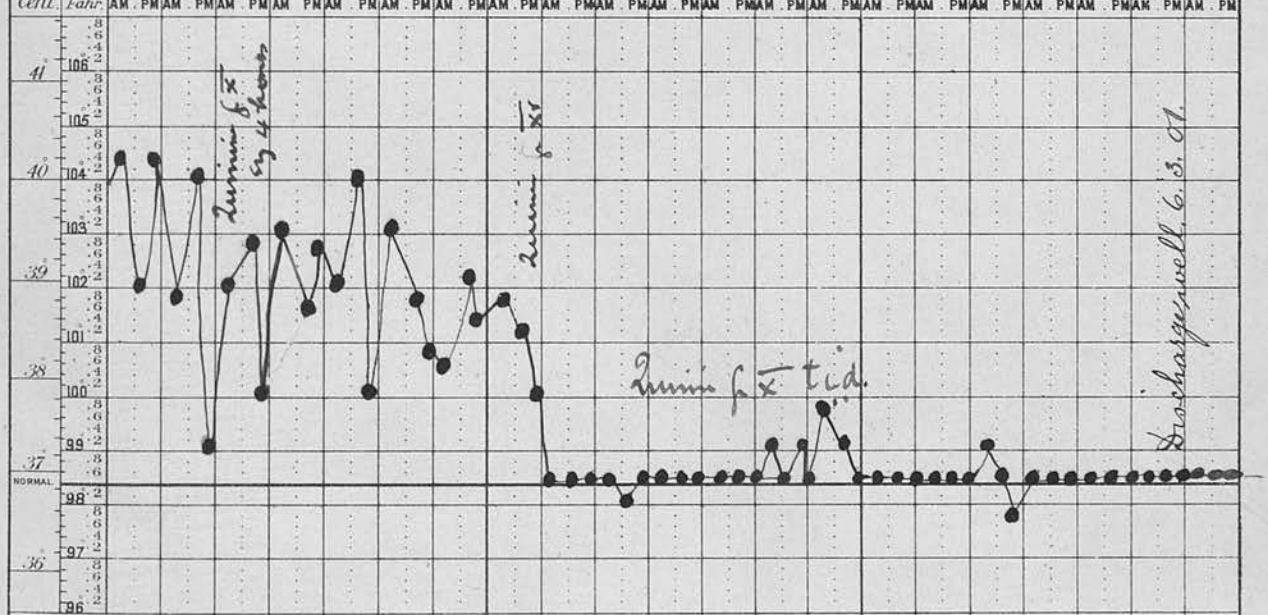
NAME. William Lull RESIDENCE. 22 Charlotte Street AGE. 30 SEX. M OCCUPATION. Baker.

DISEASE. Malarial Fever (Malignant Tertian)

1907 February DATES OF OBSERVATIONS March

11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 1 2

Cent. Fahr. AM PM



Examination of blood showed Malignant Tertian infection of corpuscles - multiple - Crescents from 14th Feby to 4th March. Daily paroxysms with indistinct rigor. Observe slight rise of temperature on 24th Feby.

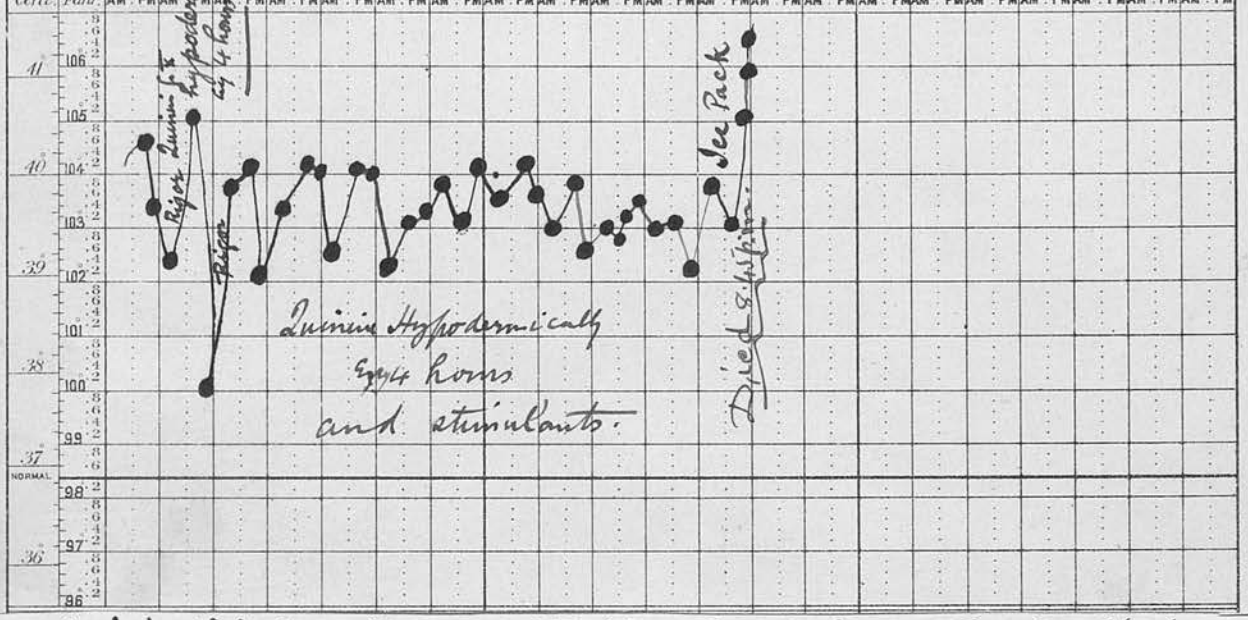
NAME. Antonio Joseph. RESIDENCE. Trois Martins AGE. 22 SEX. M OCCUPATION. Labourer

DISEASE. Fever (Enteric?) Malarial Fever (Malignant Quotidian) Algide

1900 DATES OF OBSERVATIONS

Dec[r] 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27

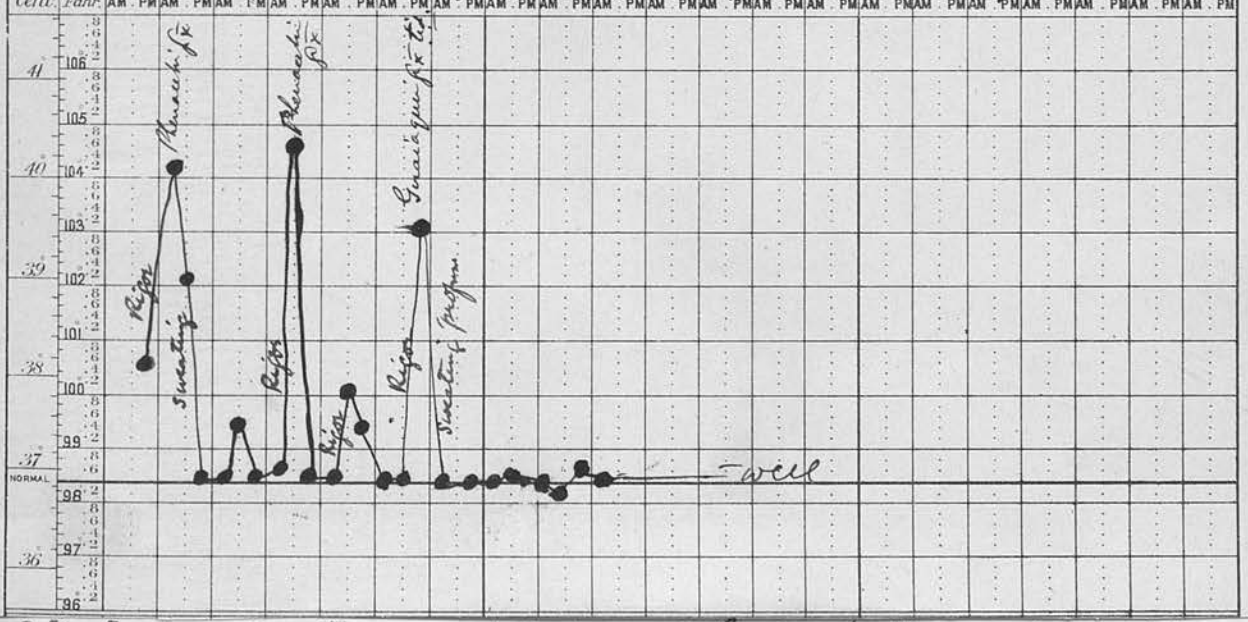
Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM



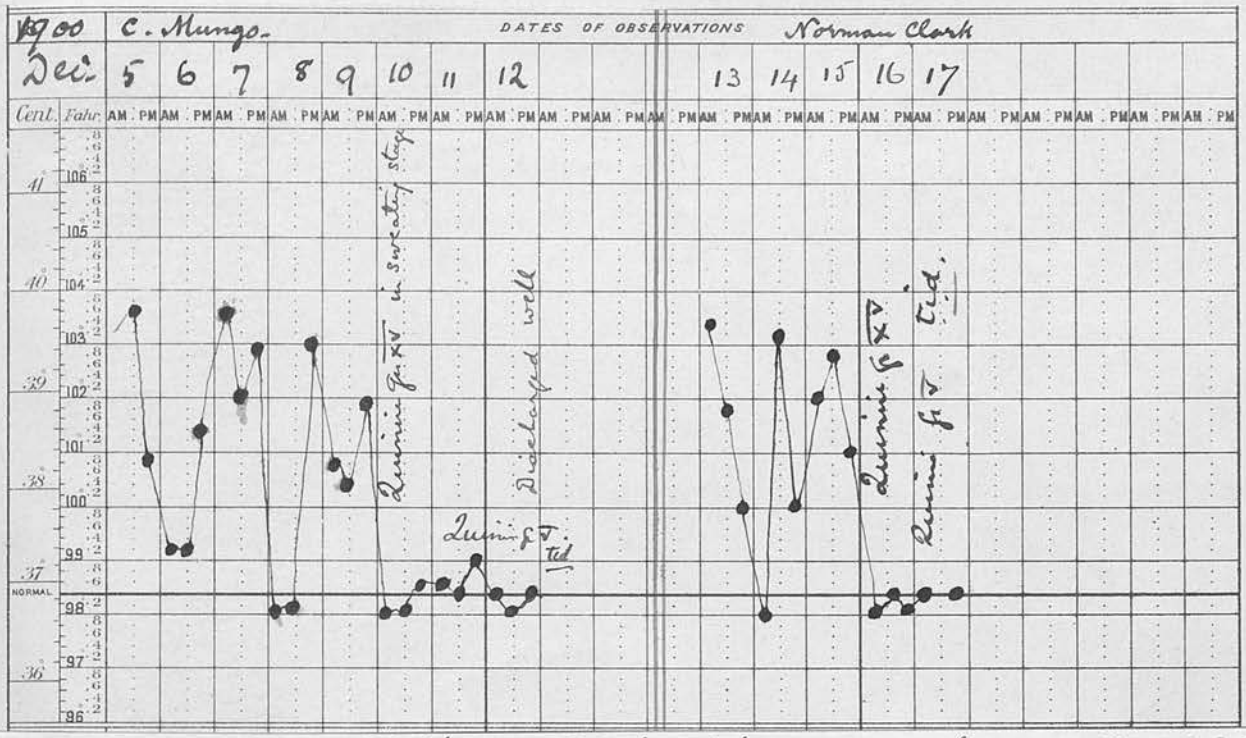
On admission 13th Dec[r] :- appearance of Typhoid Puls 94 - Resp. 35 - T 104.6 - Stools diarrhoeic and on 2nd day after admission appearance of enteric stools. Blood Exam: showed scarcely anything. Widal's reaction negative. Blood Exam. on 14th showed very minute scarcely distinguishable unpigmented spots in red corpuscles. On 15th appearances more distinct intra-corpuscular infection with Malignant Quotidian parasite. A few days later crescents appeared in blood. Hyperpyrexia before death. Post mortem: no signs of Enteric. Pigmented cells and Leucocytes in liver and Spleen - Segmenting parasites in Spleen and bone-marrow.

Nov. 8 9 10 11 12 13 14 15 16 1900 17 18 19 20 21 22 23 24 25 26 27 28

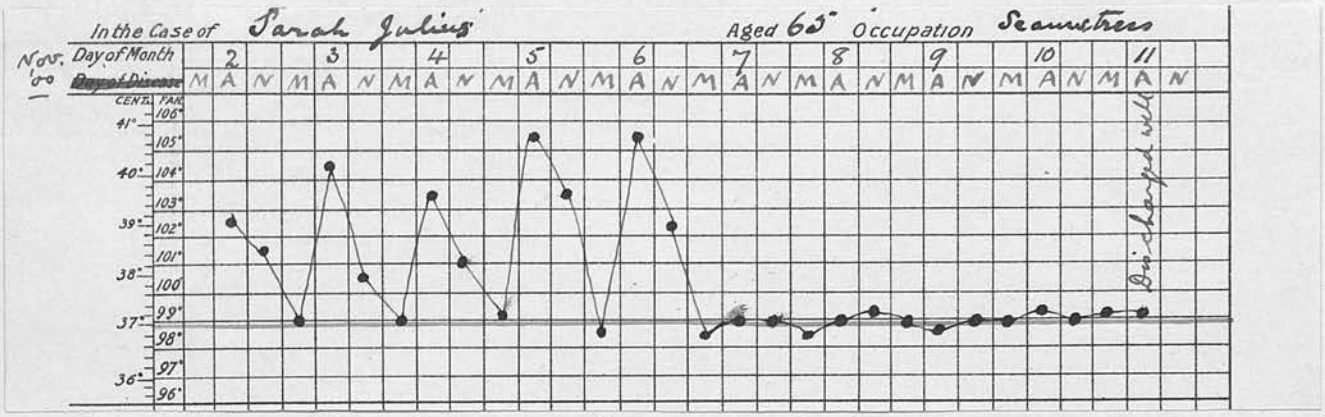
Cent. Fahr. AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM AM PM



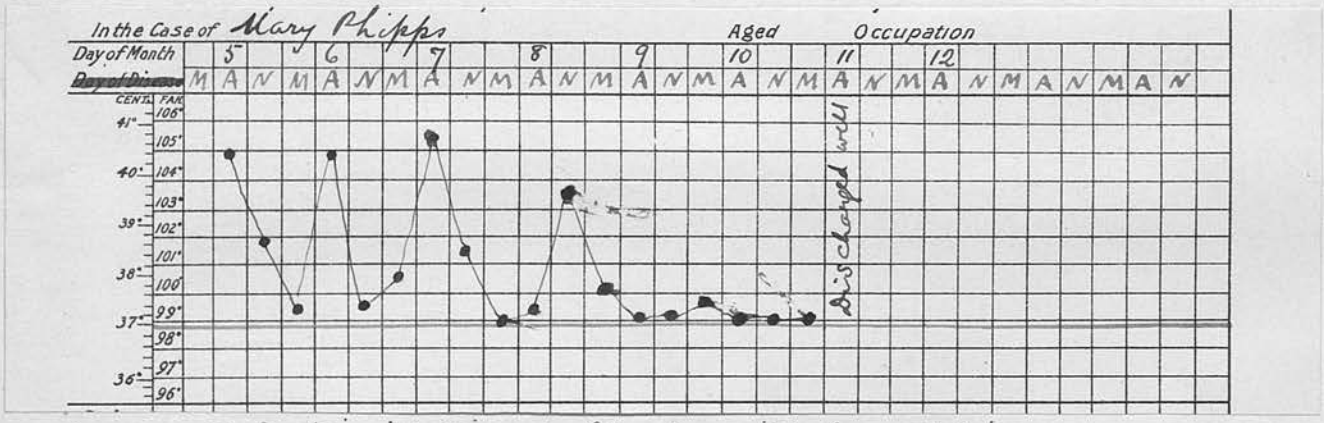
B.H.; F. æt 20. Seamstress :- a typical case of benign tertian - double infection - treated throughout by Guaiaquin in 10 grain doses. Effect on parasites similar to Quinine



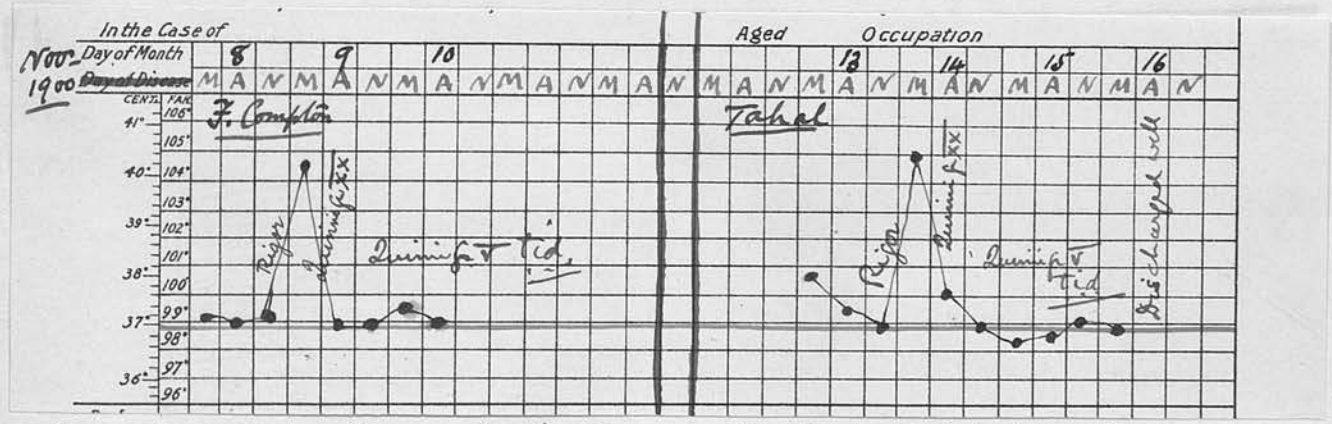
Two cases of Benign Tertian (double infection) - Parasites seen Characteristic.



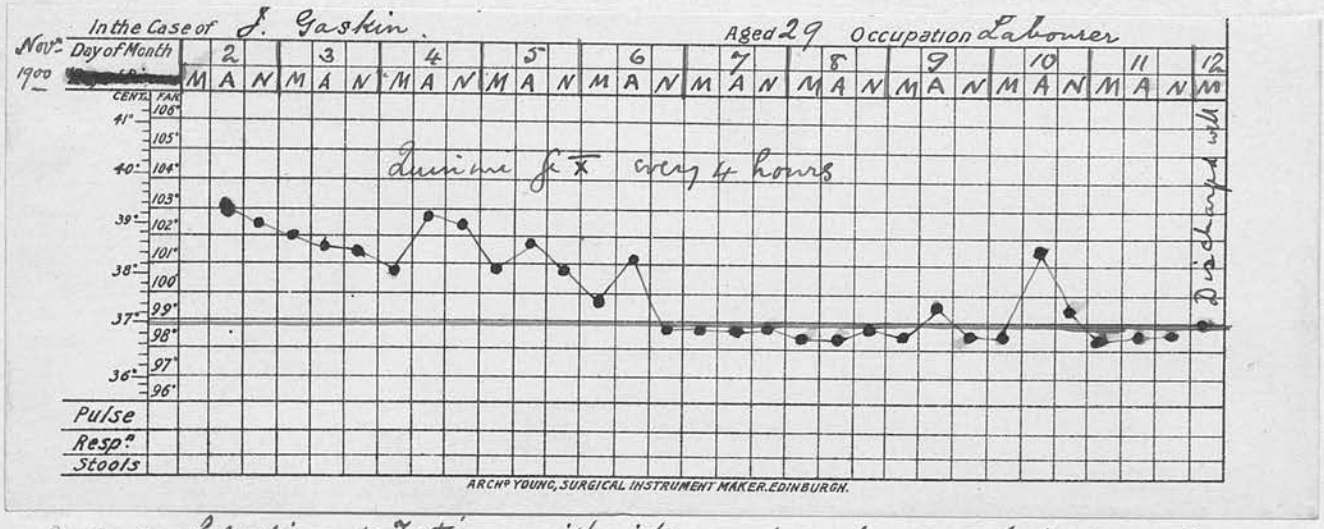
Benign double Tertian - daily paroxysms. typical parasites



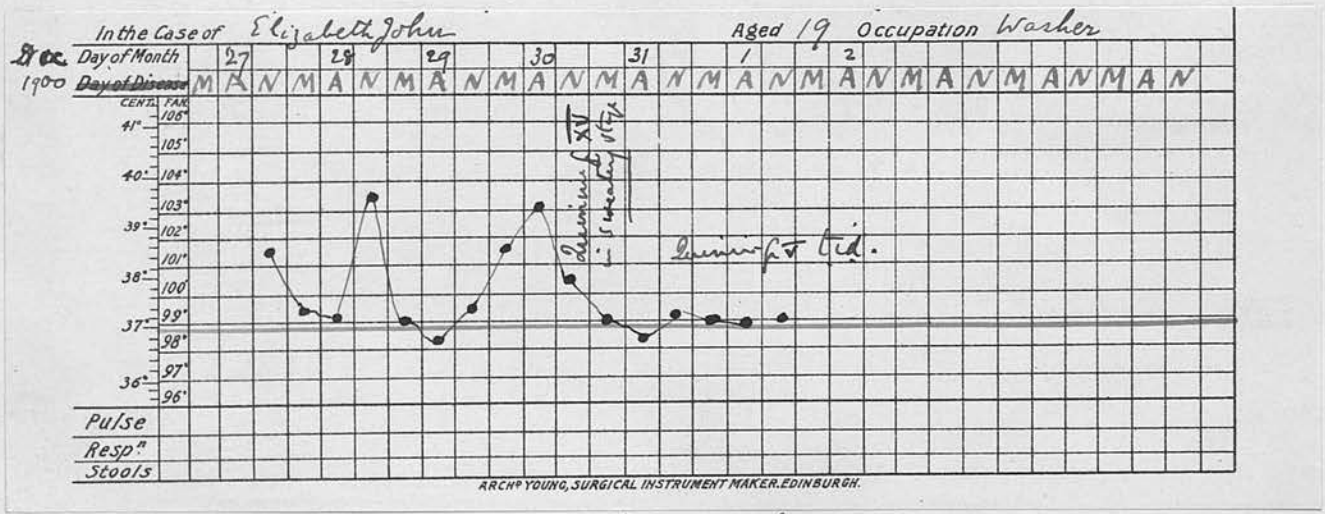
A case of Tertian infection - double - parasitic forms typical - scen



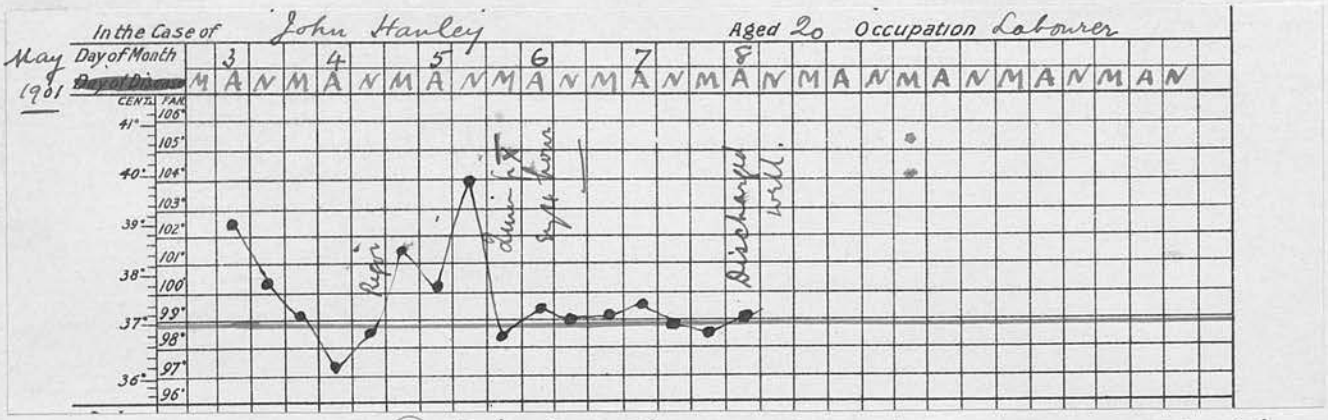
Two mild cases of benign tertian fever with characteristic parasites.



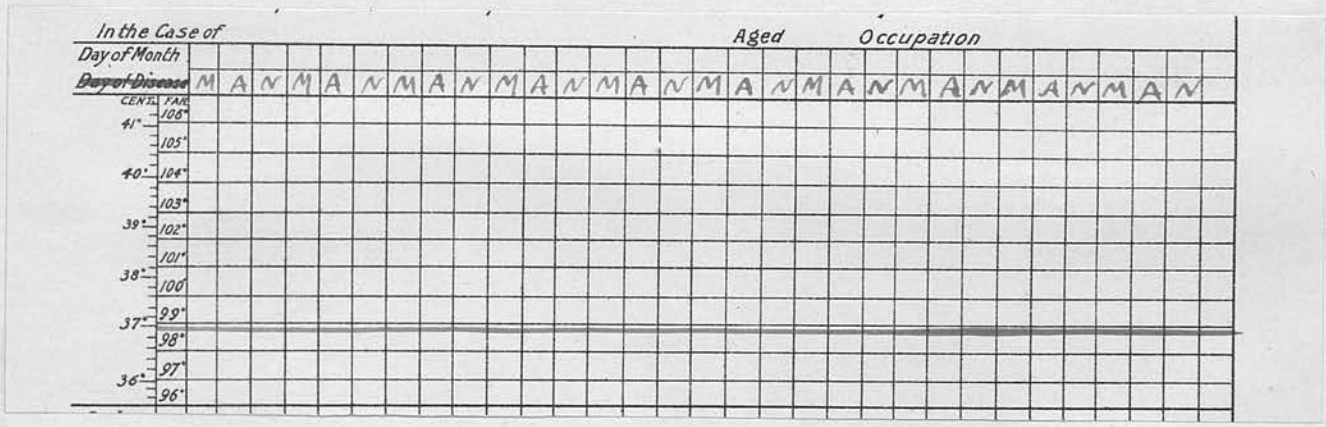
A case of Malignant Tertian - with intra-corpuscular amoeboid parasites
Crescents appeared on 6th Nov.r, and persisted up to day of discharge



A Case of Benign Tertian - Parasites found in blood in different stages.
Paroxysm occurred in postpartum period 3 days after childbirth.



A case of Malignant Tertian infection; multiple intra-corpuscular infection Crescents on 5th May - & Pigmented Leucocytes - A few crescents on day of discharge—



ANALYSIS OF FOREGOING CASES AND CHARTS.

No. of Cases of Benign Tertian,	
(1) Single	13
(2) Double or Multiple	39
No. of Cases of Benign Quartan	1
No. of Cases of Malignant Quotidian	16
No. of Cases of Malignant Tertian	6
Total No. of Cases	75

No. of Deaths from Malignant Quotidian . .	3
No. of Deaths from Malignant Tertian . . .	2
Total No. of Deaths . . .	5

Treatment by Quinine, Carbolic Acid, Guaiaquin, Phenacetin, Creosote, shown on Charts; Typical results of post mortem examinations also shown.

ADDENDUM.

COLLECTION OF TRINIDAD CULICIDAE.

In connection with the subject of Malaria and its prevalence in any locality a study of the culicidae present in that locality is of the highest importance.

With the assistance of Mr Theobald of the British Museum, (who has recently written an excellent monograph on the "Culicidae of the World") and who kindly went over with the writer and named the specimens in a collection of culicidae which he brought from Trinidad, he is able to furnish the following description.

The collection consisted of fifty-two pinned specimens of mosquitoes which were all caught by the writer in the malarious district of Chaguanas, Trinidad. They were killed with chloroform vapour and mounted immediately after death.

No. 1. ANOPHELES ALBIPES (Theobald) - identical with Anopheles Argyrotarsis, described in the text, except that the last tarsal joint in the hind legs has a very distinct deep black basal band.

No. 2. CULEX ? - in a bad state of preservation, only/

only the head and thorax being present, with the front legs.

No. 3. STEGOMYIA FASCIATA (Fab.)

Synonym - Culex fasciata.

Head - palpi short and four-jointed.

Thorax - brown; two median parallel lines on dorsal aspect and a curved silvery one on each side.

Wings - unpigmented.

Abdomen - black with white basal bands and lateral spots.

This mosquito is the agent in disseminating Yellow Fever, as has been demonstrated in Cuba by the American Commission. It is also one of the mosquitoes which forms the intermediate host of Filaria Bancroftü.

No. 4. STEGOMYIA or CULEX FASCIATA

No. 5. CULEX FATIGANS (Wied.)

Synonym - "Grey mosquito" (Ross).

Head - brown - palpi short.

Thorax - brown, with two dark lines on dorsal aspect.

Abdomen - dark brown to black with basal white or creamy curved bands and white lateral spots.

Wings - unpigmented.

Legs - dark brown, bases of coxae and femora pale.

This/

This mosquito is the intermediate host for "Proteosoma", the haematozoon of birds. It is also the intermediate host of the Filaria Sanguinis (F. Bancroftü).

Nos. 6 to 16. ANOPHELES ALBIPES

Nos. 17 to 23. ANOPHELES ARGYROTARSIS - described in text of thesis.

Nos. 24 to 28. JANTHIOSOMA MUSICA (Say)

Synonyms - Culex mexicanus.

Culex musicus.

Head - yellow, eyes black, palpi and proboscis brown with purple reflections in some lights.

Thorax - brown (metallic) with purple reflection, covered with flat yellow scales as well as bronze.

Abdomen - deep purplish brown above, when viewed pointing from the light, when pointing to the light brilliant metallic violet and purple.

Legs - brown in some lights, purple, with metallic lustre in others. The two last tarsi of the hind legs and the apex of the second, pure white.

Wings - brownish tinge and iridescent.

Nos. 29 to 36. PANOPLITES TITILLANS (WLK.)

Synonym - Culex Titillans.

Head/

Head - palpi short; abdomen - brown.

Wings - densely scaled along veins with broad flat scales.

Legs - mottled and banded with white.

Nos. 37 to 43. CULEX SERRATUS (Theo.)

Head - brown.

Thorax - dark brown with a stripe of grey in the middle of dorsal aspect.

Abdomen - brownish black with purplish reflections.

Wings - dusky with yellowish tinge.

Legs - dark brown; in some lights, metallic blue and purple.

No. 44. HAEMAGOGUS CYANEUS. (Fab.)

Synonym - Culex Cyaneus

Head - black, proboscis long, deep violet or black.

Thorax - deep blackish brown with metallic blue lustre with brilliant green and violet scales.

Abdomen - black, with brilliant blue and violet scales - lateral white spots at bases of segments forming lateral white lines.

Wings - like those of culex.

Legs - metallic blue.

No. 45. JANTHIOSOMA MUSICA (Say)

No. 46./

No. 46. PANOPLITES TITILLANS.

No. 47. CULEX SERRATUS.

Nos. 48 to 49. CULEX FATIGANS.

No. 50. ANOPHELES ARGYROTARSIS.

No. 51. WYEOMYIA LUTEOVENTRALIS (Theobald)

Head - covered with flat scales with metallic lustre, palpi very short.

Thorax - deep brown - metanotum with bristles in its posterior half.

Abdomen - unbanded.

Wings - unpigmented; with blackish brown scales.

No. 52. WYEOMYIA TRINIDADENSIS (Theobald)

Same description as Wyeomyia L. except by its black scaly appearance and that the abdomen has silvery white lateral spots which form bands apically. The white abdominal bands are very clear and also the white on the tarsi. The Proboscis is very long.

Habitat - in Trinidad, in cocoa groves bordering forests. They do not enter houses.

In addition to the above fifty-two Culicidae, there were in the collection fourteen Dipterous insects which though at a first glance appeared to be culicidae, were found to be unmistakably Tipulidae and Simulidae, insects which are of interest from an entomological standpoint only.